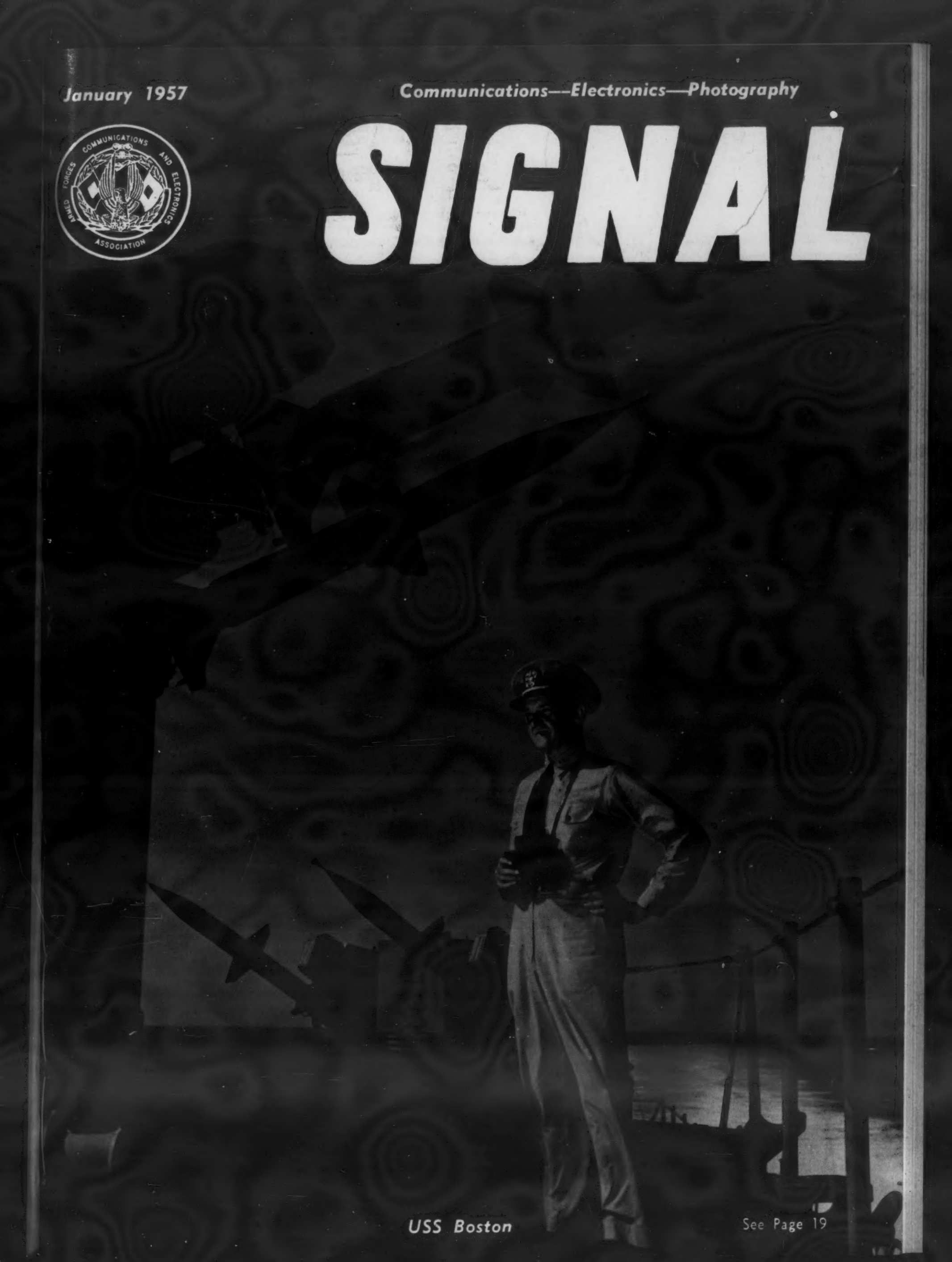
January 1957

Communications—Electronics—Photography

SIGNAL



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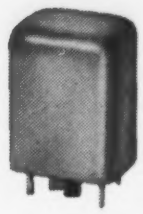


These are the smallest hermetic audios made.

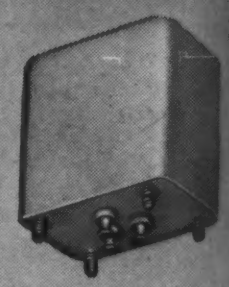
Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight.8 oz.

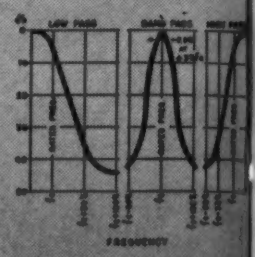
TYPICAL ITEMS

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

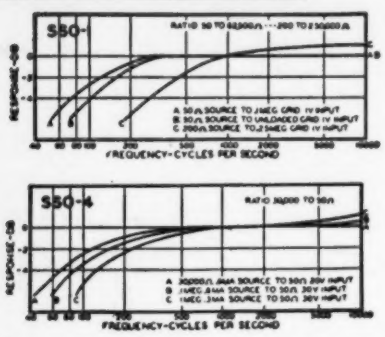
Can be used with higher source impedances, with corresponding reduction in frequency range and current

COMPACT HERMETIC AUDIO FILTERS

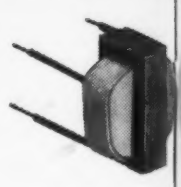




UTC standardized filters are for low pass, high pass, and band pass application in both interstage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8 — 2-1/2 high . . . Weight 6-9 oz.



SUB-SUBOUNCER AUDIO UNITS



UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniature size. Constructional details assure maximum reliability. SSO units are 7/16 x 3/4 x 43/64 . . . Weight 1/50 lb.

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	370
SSO-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	325
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	3
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	4.
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	3.
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	12

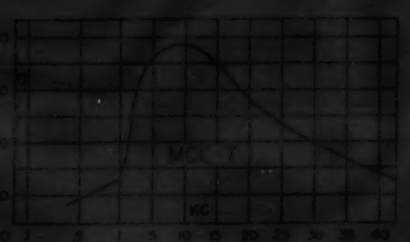
* Impedance ratio is fixed, 1250:1 for SSO-1,1:50 for SSO-3.
Any impedance between the values shown may be employed.

HERMETIC MINIATURE HI-Q TOROIDS

MQE units provide high Q, excellent stability and minimum hum pickup in a case only 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

TYPICAL ITEMS

Type No.	Inductance	DC Max.
MQE-3	7 mhy.	135
MQE-5	20 mhy.	80
MQE-6	50 mhy.	50
MQE-7	100 mhy.	35
MQE-10	.4 hy.	17
MQE-12	.9 hy.	12
MQE-15	2.8 hy.	7.2



OUNCER (WIDE RANGE) AUDIO UNITS

Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

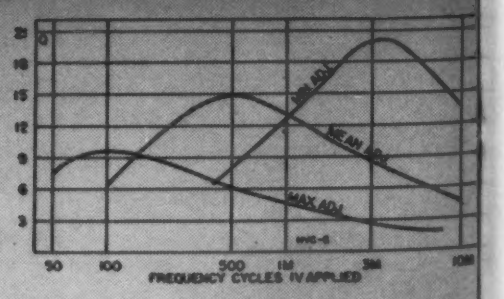
Type No.	Application	Pri. Imp	Sec. Imp
-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
-4	Single plate to 1 grid	15,000	60,000
-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

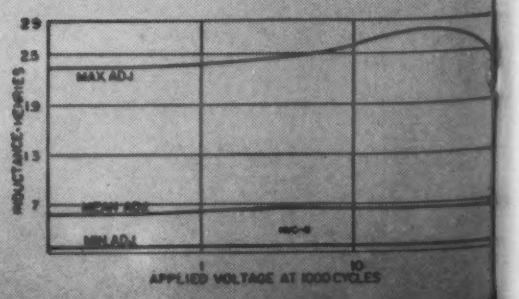
HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10 - 1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.

TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5





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SIGNAL

Communications-Electronics-Photography

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BPA

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Features

Departments

Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

Mobile communication . . . Rock-of-Gibraltar type

The short-wave radio transmitter and receiver illustrated above is known as GRC-19, and we build it for the U. S. Army Signal Corps.

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Second is *cost-watching*. Under a research and development contract aimed at reducing costs of communication gear, we designed a model of the AN/GRC-19, eliminating some of the automatic features, and costing substantially less than the automatically tuned model. This new set, the AN/GRC-65, will serve in those field applications where manual tuning is satisfactory. Our government is a shrewd buyer. We're proud to have its patronage so often.

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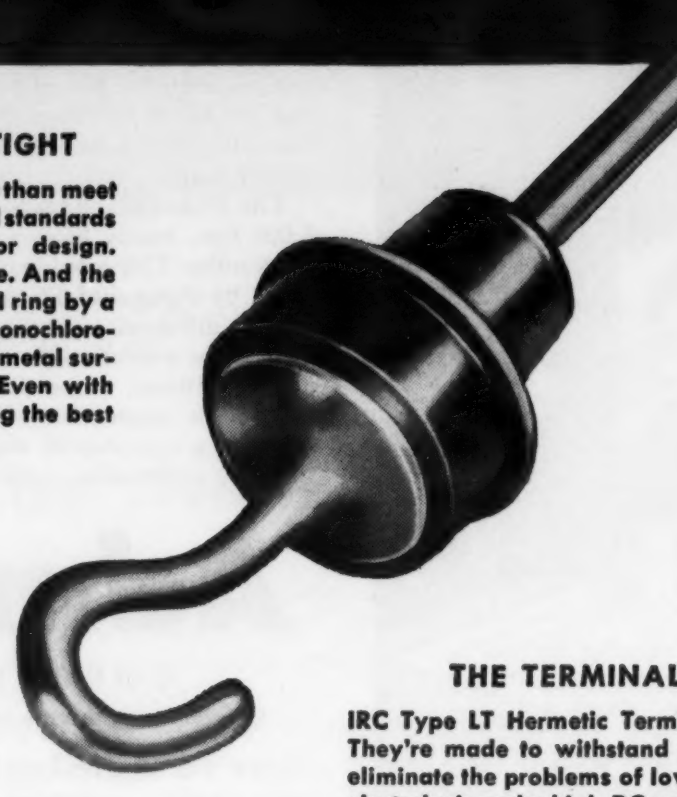

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THE SEAL STAYS AIR-TIGHT

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the DEW LINE *Story*

by Arthur B. Goetze
PRESIDENT, WESTERN ELECTRIC CO.

BY NOW THE DEW LINE, OR Distant Early Warning Line, has become a "by-word," not only among the people of Bell System, but among the majority of people in the United States and Canada as well. However, quite naturally it has different significance to different groups. To the general public it is a chain of radar stations somewhere "way up north." To those thousands of men—both American and Canadian—who have been directly associated with the project, it carries an entirely different connotation. These men have experienced the "blood, sweat, and tears" of the DEW Line stretching from the northernmost tip of Alaska to the Baffin Island Coast on the eastern end of Canada. In between these two groups are the scientifically-minded men and women who have a genuine interest in a project such as this, because of its technical involvements, its size and scope, and its importance to the protection of the American way of life. It is to this third group that my discussion here is directed.

The readers of SIGNAL recognize of course that security considerations limit the scope and nature of the information concerning this project that can be published. There can be no disclosure of classified information. After all, security measures have been designed to defend from internal threats the same freedoms which the DEW Line is being established to protect against external attack. For this reason, my discussion, of necessity, must be conducted in very general terms.

The objective of the DEW Line is to provide a detection and communi-

Mr. Goetze has been president of the Western Electric Co. since September, 1956, and a director of the company since 1953. He has served in many key posts in the communications field.

cation system capable of furnishing reliable warnings of crossings of the line by airborne objects of the types now existing or expected to exist in the near future. All phases of the design and operation of the line have been developed around the fundamental principle of augmenting and supporting this basic requirement.

Detection is accomplished by radar systems of both search and non-rotating types, thereby providing two basically different and complementary means of obtaining the desired information. Communications systems are of the VHF ionospheric and UHF tropospheric scatter types and are, of necessity, employed both for lateral communication across the line and for rearward communication to defense bases.

antenna. This has been housed in a rigid plastic radome, 55 feet in diameter, a very ingenious assembly of some 361 pieces of plastic of only 5 basic shapes.

Problems of Construction

Once this system had been conceived in the minds of some of our country's greatest scientists, the task became one of establishing and supporting it in the Arctic region. This chapter of the DEW Line story has presented problems which are as fascinating as they are unique and difficult. Imagine, for example, the construction of buildings and the installation of complex electronic gear in the middle of a bleak, treeless Arctic waste where nothing but frigid white

Clearing snow from ice landing strip

All equipment has been designed and developed to emphasize the accepted practices of automatic operation, ease of accessibility of components to facilitate maintenance problems, and a low false alarm rate. Its uniqueness—in those cases where standard types of equipment could not be used—lies in the fact that it is designed for reliable and uninterrupted operation for long periods under extreme Arctic conditions and temperatures. Antennas and other outside plant equipment have been constructed to withstand extreme cold, snow, rain, ice, and high-velocity winds, all of which are common experiences in an Arctic environment. Only one item of material which is normally considered as outside plant has been provided with protection from the elements—the search radar

barrenness meets the eye in any direction you turn. Imagine the planning necessary to support more than 7,000 construction people, to do it quickly, and at a time when there wasn't a nail, or a board for a piece of equipment to start with. It has been a stupendous task—vastly different from any other in our history —and stands as a splendid example of teamwork between the United States and our good Canadian neighbors.

But let's start at the beginning. First, extensive survey work was carried on during 1953 and 1954 by the Western Electric Company and its teams of specialists from the Bell System Companies, and a number of possible routes across the Arctic were studied in great detail. Aerial reconnaissance at low levels was performed, both in winter and summer, and something on the order of 80,000 photographs were taken, to be analyzed and evaluated along with various reports which were available covering the areas being considered.

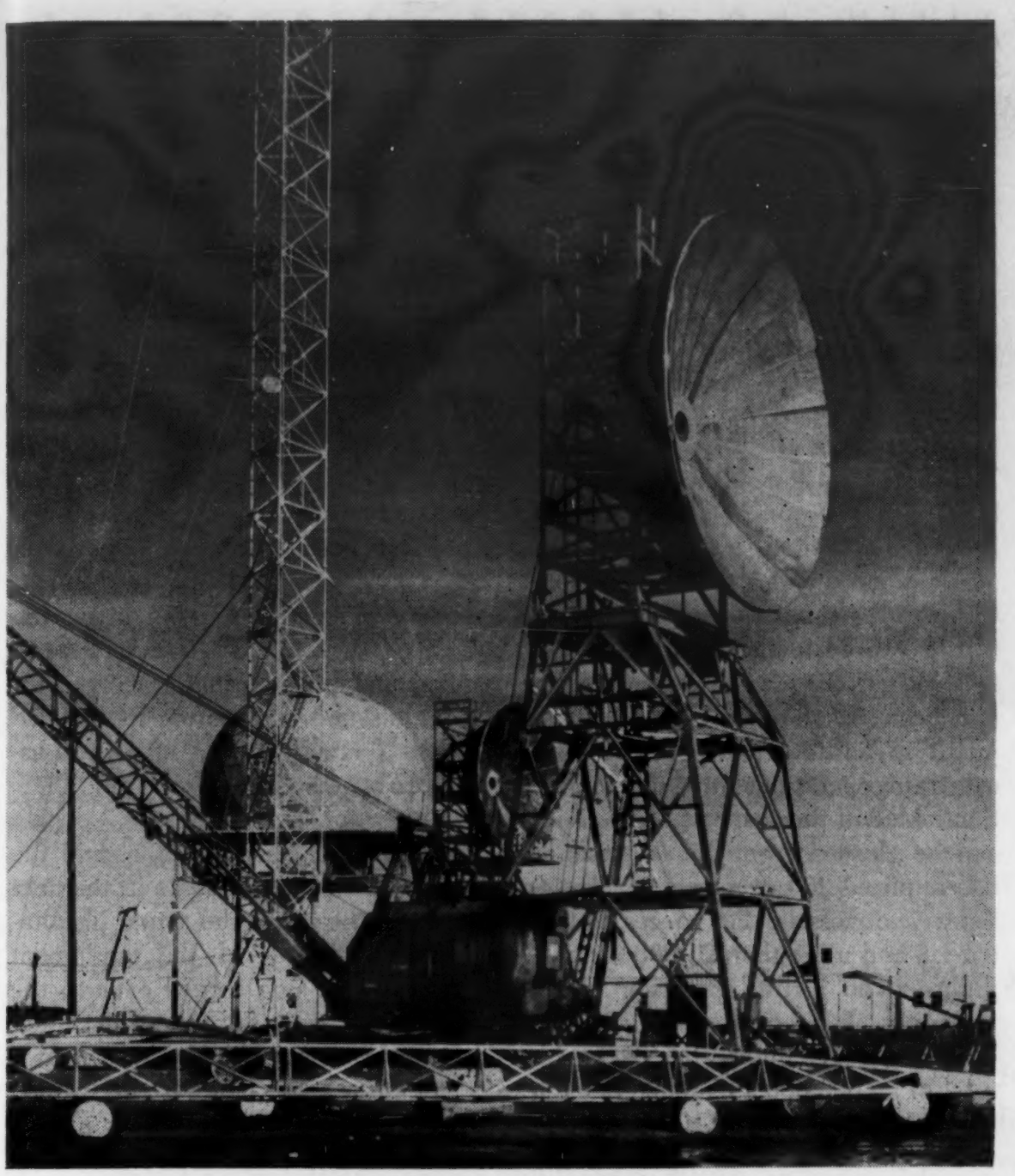
Discussions were carried on with both United States and Canadian citizens who had had first-hand knowledge of the areas, and valuable experience was obtained by actual participation in various sea resupply missions throughout the area. Data gathered by all these means were compiled and evaluated, giving specific regard to detection capabilities, construction, logistics, and operating problems. Finally, after painstaking analysis, an optimum route was recommended.

Choosing Sites

Final site locations depended upon "on the ground" surveys in order that maximum advantage could be taken of local terrain conditions. Construction schedules already established required that these surveys be conducted during some of the most severe weather conditions encountered in the Arctic. Siting engineers landed by bush plane in the middle of nowhere, lived in tents, slept in their clothes in 50-degree-below-zero cold, and endured wind that scrapes like a file and a whiteness that makes the human eye beg for relief. And as if the job were not already sufficiently unpleasant, there was always the threat of polar bears—a possibility which time proved it was never safe to disregard. Yet the men stuck to the job and developed the information which was needed to determine the location of the stations of the DEW Line System.

Overlapping some of the final siting activities, path testing operations were carried on in order to determine transmission characteristics between proposed station locations. Most radio transmission people are familiar with these problems in normal conditions within the boundaries of the temperate zones. But in the perishing cold of a region, virtually unmapped, the task of developing dewpoint readings is transformed into a mighty tough job.

Much of this activity was carried on during the long Arctic winter when sunlight was only a memory.



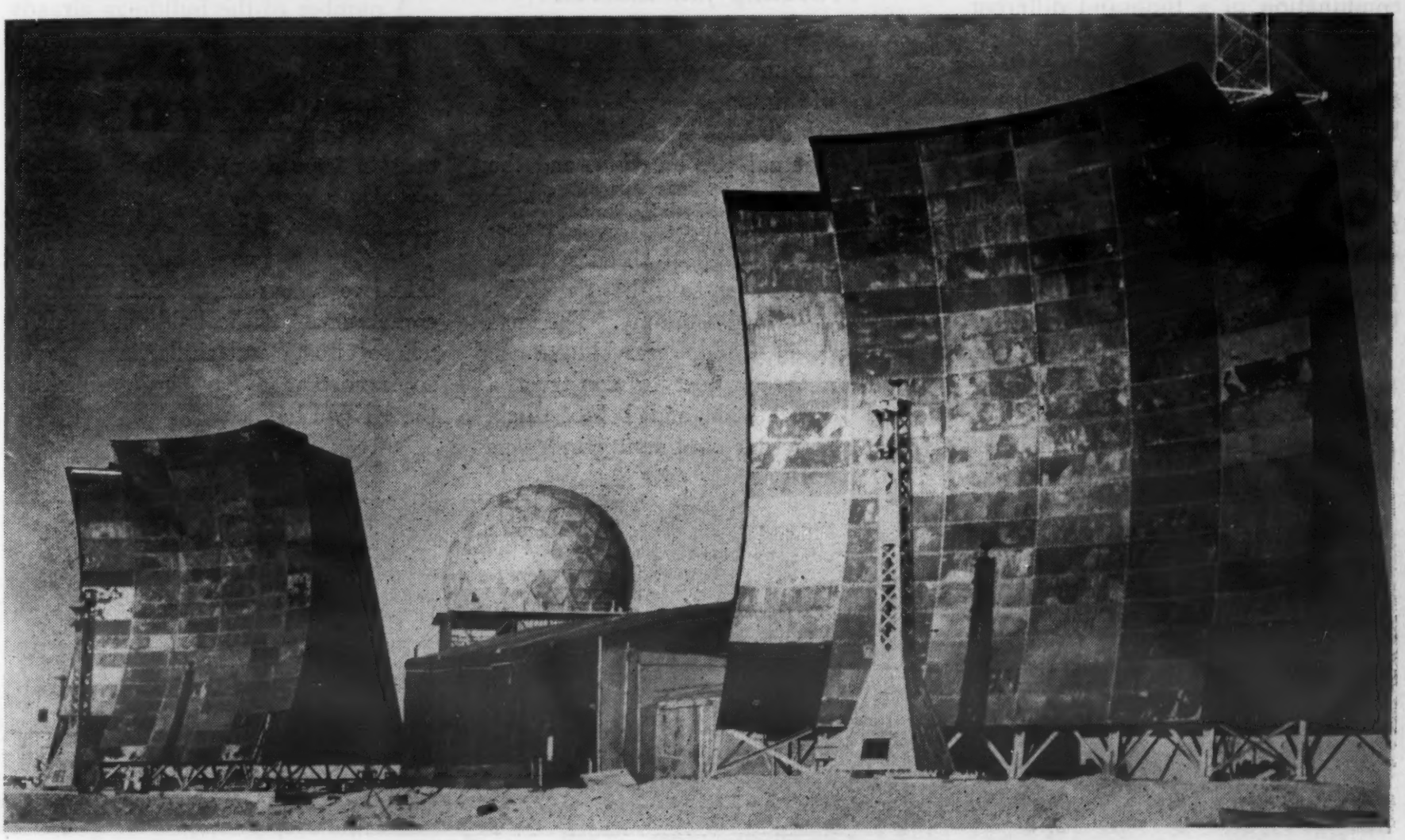
30' UHF parabolic reflector used in lateral communications

Carrying a flashlight in bitter cold weather is a nuisance, but when it is too dark, even at high noon, to read a psychrometer, it becomes a very necessary nuisance. Extreme care also had to be taken when siting with a theodolite to keep frost crystals from gathering on the lens at one end, and to keep one's own eyelid from freezing fast to the eye-piece at the other.

Still another source of frustration stems from the fact that siting is largely a trial and error activity. A station location can be determined as scientifically as the present state of the art will permit, but a subsequent radiowave "fix" for orientation of the equipment may indicate that another three hundred yards to the east would probably be a better spot. And interspersed with all these problems is the ever present human need to "get in out of the cold" at frequent intervals to avoid permanent damage from frostbite.

Also overlapping siting activities comes the matter of detail design and the preparation of engineering specifications. This phase of the project has required the preparation of thousands of drawings, all of which had to be checked, approved, and cata-

(Continued on page 12)



60' parabolic antenna used for DEW Line communications

logued, and lists of materials developed. The work represented by the drawings had to be scheduled and phased together in accordance with the latest available information with regard to developmental work, manufacturing intervals, transportation requirements, sea and airlift facilities, and the availability of manpower.

Placing the Orders

Next came the procurement phase which started us on the long trail of locating qualified suppliers and placing orders. The DEW Line is not a system of Western Electric, or Bell System equipment. *Thus far, nearly 3,400 separate suppliers in the United States and Canada have been manufacturing DEW Line items under a continuous stream of some 64,000 separate purchase orders.* A big half of these orders have been placed with Canadian suppliers, a fact which contributes immeasurably toward easing transportation problems by shortening the supply routes to the northern sites.

Some Western Electric Company materials are used, but it is as the prime contractor for the Air Force that our contribution to the project is made. It is in this capacity that we act as the central control in a total effort requiring more items than any combination of a thousand different companies is equipped to produce. The tremendous number of suppliers and manufacturers cannot be listed here, but they include all the familiar names in the field of electric and electronic communications industries, as well as many, many others not so well known, but who have nonetheless played an important role in equipping the DEW Line.

Finding a source of supply for each needed item was a big job. Transporting it from where we found it to where we needed it turned out to be an equally big job. Transportation is sometimes a knotty problem right here in the United States, but just consider this sort of a situation, if you will—a trip involving transportation of many tons of equipment from Buffalo to Edmonton, Canada, and then to Grimshaw by rail; from Grimshaw to Hay River by truck; from Hay River to Tuk Tuk by barge; down the Mackenzie River by barge; and finally across the tundra by cat train to the DEW Line sites. Then insert a few of the oft-encountered problems such as ice in the lakes and soft mud in the land routes and you get an idea of the recurring torture that transportation people were required to face.

Much of the transportation activity has been accomplished by sea and airlift in addition to the barge and cat train operations just mentioned. Some idea of the scope of the activity can be gleaned from the fact that it has required 200 deep sea vessels, 80 lighterage vessels, 20 barges, 1,000 trucks, and more than 25,000 aircraft flights. The airlift operation alone, including 24,950 commercial and 500 U. S. Air Force flights, has covered a total of 26,000,000 air miles—enough to send a squadron of 100 planes 10 times around the world!

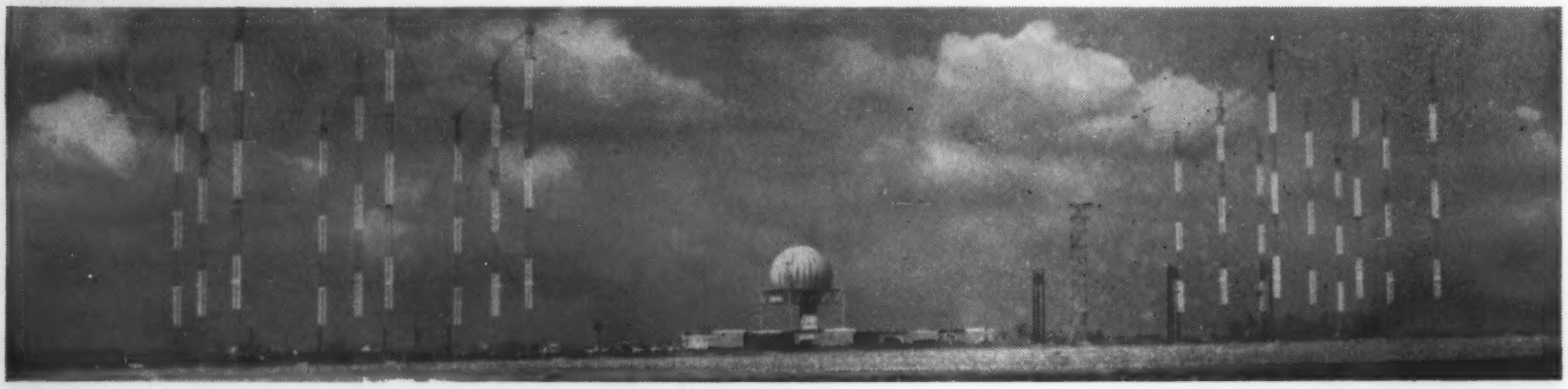
Providing for Material

Once the material is on its way north, the next problem is the provision of airstrips, roads, beaching area, and storage space to bring it into the actual site location, and the construction of the buildings which will permanently house it. In connection with the first of these requirements, it has been said that the DEW Line is a "gravel economy." The facts bear this out. Enough gravel has been used on the project to construct a road 18 feet wide and 1 foot thick, clear across our continent. Buildings for the DEW Line sites have been designed to meet three basic requirements: first, they must be comfortable, adequate, and sufficiently flexible to meet personnel and equipment needs; second, they must be resistant to fire, wind, cold, storm, and deterioration, and third, they must be simple and economical to transport, construct and maintain at Arctic sites.

Extensive studies were carried out in connection with various types of concrete, metal, metal-clad, and wooden structures before the final decision was made to use a series of modular units assembled from prefabricated insulated plywood panels. This modular technique has proven highly successful. Modules have been assembled and outfitted at convenient locations and transported in finished form as much as 200 miles for assembly into the building train at their final location.

With the material on site, and the buildings to accommodate it, the next phase of the job is the actual installation and testing of the equipment prior to its being turned over to the Air Force, ready for operation. Manpower for this effort has been drawn from all over the Bell System, trained at the prototype installations in Illinois, outfitted with Arctic gear, and transported to the DEW Line sites.

A number of the buildings already have been accepted by the Air Force. The installation of equipment at many locations is well along and testing activities are being carried on. Soon, the full story can be told—a complete account of the adventures of thousands of Americans and Canadians (and we would be remiss if we failed to recognize, too, the splendid contribution of the Eskimos)—all of whose efforts and skills have played so important a part in establishing the DEW Line.



Corner reflectors used in rearward communications

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degradation rate tests for TI's USN-2N117 and USN-2N118 silicon transistors

test	condition	duration	end point at 25°C
lead fatigue	three 90-degree arcs	—	no broken leads
vibration	100 to 1000 cps at 10 G	3 cycles, each x, y, and z plane	I_{CO} = 2μA maximum at 5V
vibration fatigue	60 cps at 10 G	32 hours, each x, y, and z plane	h_{ob} = 2μmhos maximum
shock	40 G, 11 milliseconds	3 shocks, each x, y, and z plane	h_{fb} = −0.88 minimum for 2N117
temperature cycle	−55°C to +150°C	10 cycles	h_{fb} = −0.94 minimum for 2N118
moisture resistance	MIL-STD-202	240 hours	
life, intermittent operation	P_c = 150 mW, V_c = 30V	1000 hours, accumulated operating time	
life, storage	150° C, ambient	1000 hours	
salt spray	MIL-STD-202	50 hours	no mechanical defects interfering with operation

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the Role of Communications in Air Traffic Systems

by

Captain Donald B. Nowakoski, USAF

CHIEF, SUPPORT SYSTEMS BRANCH
OFFICE OF FUTURE SYSTEMS
AIRWAYS and AIR COMMUNICATIONS SERVICE, MATS

THE AIR TRAFFIC SYSTEM CONSISTS OF A MYRIAD OF closely interlaced sub-systems, any one of which is inadequate in itself. The sub-system under discussion here is the communications network which supports the entire Air Traffic Systems structure. It is not the intent of this article to revolutionize Air Traffic concepts, but to point out the urgent need for keeping pace with the state of the art involving communications. Further, it becomes necessary to view the capability of the traffic system from the standpoint of information flow from aircraft to ground to aircraft and ground station to ground station. It follows that the overall system capability is only as effective as the communications which makes the system possible. Loss of even a small amount of this talk power requires realignment of numerous procedures and control standards, to the detriment of traffic flow.

Obviously, the ability to communicate faster and increase the amount of intelligence which may be passed in a given time period, lessens to a great extent the processing time of any given traffic condition. Aircraft in steadily increasing numbers are flying higher, farther and faster. So fast, in fact, that we cannot communicate at a rate comparable to the flight situations. The philosophy that high speed aircraft may be flown at extreme altitudes with relative safeness in the absence of air traffic regulation is short sighted. At high altitudes and high speeds, there is no such thing as Visual Flight Rules. In reality the term VFR is fast disappearing from the air traffic scene. Since instrument flight can be conducted only in the presence of adequate communications, it goes without saying that the communications system supporting these flights must be vast in scope, extremely reliable, versatile and capable of evolution. Automaticity provides the only means by which we may accelerate and expand our systems capability.

Expanded Communications Needed

What is needed to reach this happy state of semi-automatic operation placing us in readiness for fully automatic systems? Communications—in expanded, modified, improved and vastly new forms. Some of these imposing requirements will be mentioned, realizing full well that this system will be tremendously expensive. Understanding that approximately 125,000 aircraft will be flying in the United States in 1975 and that these aircraft will make three to ten times as many flights per

aircraft as they do today, and the fact that control technique is obsolete by today's standards, so called "improvements" using yesterday's communications is a step to the rear. The following assumptions are made after careful consideration of civilian and military capability and current state of the art.

(1) Intercenter communications system employing teletype or voice is too slow and lacks required capacity.

(2) Air to ground and ground to air voice is cumbersome, slow and inadequate. Its use must diminish but will never quite disappear.

(3) Manual display of electronically derived data is archaic and only introduces further delay in electronic data processing.

(4) The use of spectrum for air ground which allows line of sight coverage in terminal areas of restricted airspace configuration is not good sense. Airport surface communications, for example, require a maximum coverage of 1 or 1.5 miles.

Revision of Basic Concepts

Modernization of the Air Traffic Systems and providing a built in evolution capability will require revision of certain basic concepts and realignment of our air traffic thinking. In order of importance, let's look at some of aspects that have been considered at length and the conclusions which may be reached.

(1) The rate at which aircraft control may be exercised, which determines the scope of the control, rests with the ability to tell someone something or have someone tell us something. We know that 90 percent of our problem is linked with this condition. Speed of transmission, reception, and processing must be vastly increased and this can only be accomplished electronically.

(2) Communications, then, is indispensable to the Air Traffic System. How much we do and how well we do it rests with our ability to communicate.

(3) Pure talk ability even in its most sophisticated form is only a small part of the overall problem. We must do something with the information which flows in fantastic quantities within the system. This information must be displayed in a convenient, dynamic form, allowing the decision-maker uninterrupted concentration on his primary job—maintaining safe air operation. The display facility and any electronic processing equipment is a part and parcel of the communications system, to no lesser degree than the radio transmitter itself.

The barrier preventing the immediate transition to a semi-automatic Air Traffic System is the lack of means of providing adequate intelligence at rapid rates to the system. It has been proposed that as a first step the teletype be used to pass the flight plan information and process automatically a flight strip identical to that in use today. At 100 word per minute transmission speeds, considering that between 50 and 75 percent of the transmitted message is blank to provide for numeral or character positioning on the flight trip, too much time is consumed sending the required information. Unacceptable transmission delays result as backlogs develop on busy circuits and the flight plan of the aircraft due at a terminal first may not arrive prior to the flight plan on an aircraft due some time later.

The first step then, in providing "information" to the controller in a timely manner is conversion of the entire Air Traffic System's intercommunications network from teletype to high speed data. A number of satisfactory data transmission systems are in use today for passing airline reservation information, collecting voluminous status type reports and others.

As conversion to data is affected, weather, flight plans, airport condition and much other information may be exchanged rapidly and accurately.

So far, however, we have not improved the means of making use of this data. The existing methods of displaying the flight plan and other data to the controller requires that a person or persons manually insert the flight strip into a holder and then position it in a suitable flight progress board. All of these functions may be performed automatically with the flight plan mechanically or electronically displayed instantaneously in its appropriate position before the controller when received. The controller should not be required to collect, disseminate, or dispose of flight plan data, but should be left free to concentrate on decision making by monitoring his traffic display and forecasting sensitive situations before they occur.

Providing automatic display helps us but does not solve the entire problem. What does the controller spend his time doing? Studies have proven beyond any shadow of doubt that 90 percent of the time is consumed not by decision making but by communicating. We must reduce the talk time and provide more decision making capability per controller. To accomplish this, more concise, rapid communications are essential from ground to air and air to ground.

Use of Electronic Storage

The air-ground data link is capable of doing this job swiftly and effectively. Essential air derived information may be transmitted to the ground automatically as well as on an interrogation basis. The interval between automatic air to ground reporting may be established at that which is most convenient for the flight path being flown, the interval being somewhat longer during the en route portion of the flight than during the terminal area transition. When received at the ground station, this data may be scanned by electronic means and processed automatically to appropriate recipients via the inter-center data link system and displayed as required.

It is reasonable to envisage information processed via the data link and read-out for visual display to a controller anywhere in the system or transmitted to an aircraft. This places a demand upon the system for compatibility of the ground to ground and ground to air to ground data link, an entirely conceivable and desirable characteristic.

To facilitate rapid flow of the required information and curb the entry of unnecessary data into the Air Traffic Data Communications System, as well as insure the availability of information when required, electronic storage and computation may be used. Several master

storage-computer (SC) stations would be required to adequately process the vast amount of information in use. All intelligence processed by the Data Communications System would terminate in one of the master storage facilities initially. It could then be read out to the appropriate agencies, instantly in the case of initial flight plans or as required in the case of weather.

Desirable Operations

In sophisticated form the storage computer facilities interconnected by the Data Communications System would allow a multitude of highly desirable operations. For example, insertion of a proposed flight plan at the point of departure would trigger a series of events automatically, all intended to insure a firm flight plan, approach slot, and terminal airport handling facilities. This may be accomplished by processing the flight plan to the master storage-computer center having basic jurisdiction and causing it to interrogate all agencies involved in the flight, en route and terminal, to include such items as airspace reservations, airport congestion, alternate airport facilities, passenger facilities and many others. Assuming that all conditions are favorable, the SC would consolidate and insure appropriate take-off time, approach times, routes, altitudes and set up the automatic position reporting times and locations. During the flight, automatic position reports would be referred back to the original assigned flight plan, compared with the assignments and passed to the appropriate controller display. If a conflict or variation is detected a revised flight plan may be computed by interrogating automatically all stations concerned and commanding the change to the aircraft by ground air data link.

Economy Will Govern Rate of Modernization

The controller, thus relieved of the burdensome responsibility of verbally processing the position reports and command changes in flight attitude, may concentrate his full attention to decision making.

What form will this communications network take for which we have stated a need? In the first place, no startling changes will be made overnight. The system will evolve in accordance with a systematic, progressive program common to civilian and military. The rate of modernization will be governed by economics, not communications state of the art. Nothing herein outlined is beyond that which is possible to attain or already in use. Several steps follow which must be taken without delay to provide the communications foundation for the Air Traffic System needed, *not in 1975, but today*. Realizing that much is needed to implement such a system improvement, every consideration has been given to projected communications system capability based upon existing equipments as well as techniques just now being perfected.

(1) Expand, as required, the intercenter communications facilities and immediately commence conversion to full data transmission capability.

(2) The military services have already reached agreement on the technical make up of one way air-ground data link. Expand this agreement to duplex systems and arrive at satisfactory military-civil common data link standards as for air-ground-air.

(3) Accelerate program implementation of military-civil air fleet and ground station data link in the U.S. as well as appropriate locations overseas.

(4) Develop and place into operation suitable display equipment which will accept data remotely or locally and present it in appropriate form to the controller.

(5) Plan, engineer, and place into operation suitable storage-computer centers based upon the geographic air traffic configuration. The storage-computer facilities to be capable of accepting, storing, analyzing and transmitting any and all data fed to the intercenter Data Communications System from ground or air derived sources.

(6) Insure overall system compatibility by providing entry to the system by any form of communications intelligence, accepting, and processing any source derived position data on aircraft be it air derived, ground radar derived or Air Defense.

(7) Expand the Data Communications System to include processing of the myriad of information on airport condition, passenger facilities, weather, air movement, alternate airport data etc., to allow implementation of a scheduling traffic system. This system to rely upon the storage-computer center having jurisdiction over the airport of departure interrogating en route sectors and destination facilities to compile and assign route, departure and arrival time, altitudes, reporting times and positions, alternate airports, ramp times, etc.

(8) Exploit existing communications art to conserve spectrum space for ground-air communications. Reserve line of sight frequencies for applications requiring such range and provide SHF, perhaps millimetric, communications for very short range requirements.

Without Communications—No System

In relation to Air Traffic, it may be simply stated that without communications there is no system. Large amounts have been and continue to be spent for communications, yet the figure is surprisingly small when compared with the preciousness of the end result of the expenditure. Unfortunately, in the past we have not kept pace with the capability offered us by the electronics field. Happily, we may look forward to improvements and expansion which will keep pace with the ever growing need for expanded Air Traffic Systems. Communications makes itself felt everywhere, in the U. S., and abroad. It cries out to be allowed to do our jobs for us because nothing can do these jobs better. The past bleak years have taught us that we cannot possibly hope to command Air Traffic leadership without large scale modernization of the communications networks and techniques which makes this possible.

From the President

Dear Member:

As an association, AFCEA can be of incalculable value to the national defense. Communications and electronics are the backbone of military operations. Those whose business it is to manufacture or operate communications and electronics equipment are a vital part of our defense system. The responsibility for the safety of the United States falls equally on the shoulders of industry and the military. Approximately three quarters of a billion dollars will be spent in this fiscal year on the procurement of communications and electronics equipment by the Armed Forces and an additional five billion for research and development. The importance of the industries which AFCEA represents to the national defense effort is self-evident. Not only do the members of AFCEA participate in production and operation, but they are represented in the highest councils of the Nation.

AFCEA is not a trade association, nor is it a manufacturers association. It is a patriotic organization composed of group and individual members dedicated to a common cause.

As individuals, we are often prone to place too much emphasis on the last part of the stated objective of AFCEA, i.e., fostering the spirit of fellowship among industrial and service personnel. While fostering this spirit of fellowship is an important ingredient of our mission, it should not be considered an end in itself. In the words of one of our prominent directors, "We have passed the marching and chowder stage. AFCEA has come of age and the more serious aspects of our mission should not be neglected."

The primary objective of AFCEA is to maintain and improve the cooperation between the Armed Forces and industry in the design, production, maintenance and operation of communications, electronics, and photographic equipment in time of peace as well as in time of war.

How can the individual member assist in fulfilling this obligation? First by participation in chapter activities. Membership in a chapter brings to the individual the opportunity to maintain close professional contact with other members, both in industry and the Armed Forces. These contacts should be more than social. The chapter serves as a forum from which constructive ideas can be discussed and a better appreciation of the problems confronting the Industry-Armed Forces partnership can be gained. Collectively, the chapter can and should exercise a definite influence in its community. Individually, the chapter member contributes to the collective effectiveness of the chapter.

There are many individuals, however, who, for one reason or another, cannot either belong to a chapter or participate in chapter activities. These members, too, are important to AFCEA. By their very membership they lend their support to the objectives of the Association.

Membership in AFCEA is not a one way street. Your Association has much to offer you as an individual. The comradeship born of association with others of your profession in a common cause is one of the benefits. SIGNAL, the official magazine of the Association, is another. SIGNAL is a continuing contact with the profession of communications and electronics. Through its editorial pages and its advertising, SIGNAL provides a means of keeping in touch with trends and major developments of professional interest. It is a magazine worth reading. It is a publication worth keeping.

The strength of the Association and its ability to carry out its objectives depends upon the continuing interest and support of its members. Its effectiveness is reflected in its numbers. Each individual contributes to the whole. Keep up your interest, maintain your membership, and encourage others to join with you in the high objectives and benefits derived from membership in AFCEA.

May I wish each and every one continuing success, good health, and a Happy New Year.

Sincerely,

Percy G. Black

National President

U. S. Air Force Photo

An Air Force cargo plane delivers vital Air Force supplies to an overseas base.

AIR MATERIEL COMMAND IS GLOBAL LINK BETWEEN RESEARCH AND COMBAT UNITS

Supplying the Air Force with the right equipment, at the right place at the right time is the mission of Air Materiel Command. Its procurement, supply and maintenance operations fill the area between research and development on one side and combat units on the other. It is the largest business in the country.

Because our Air Force is operating in all quarters of the earth, AMC is a globe-circling operation with its headquarters centered at Wright-Patterson AFB near Dayton, Ohio.

The vital logistic mission for the Air Force involves billions of dollars in procurement, thousands of airplanes, and more than a million different kinds of supply items. Organizationally, AMC includes fourteen air materiel areas, or major area depots, located in the United States, Europe, North Africa, and the Pacific. Geographically, air materiel operations extend throughout the free world.

Working with weapons systems contractors in private industry, AMC procures the equipment which has been developed and tested by the Air Research and Development Command, and distributes the equipment to combat units as needed. The never ending objective of the Air Materiel Command is to maintain an instant combat readiness, logistic-wise, in this era of super speeds and super weapons to support Air Force operations at any point on the globe. The philosophy of Air Materiel Command is that such readiness must be characterized by the closest interrelations of combat and logistic elements, by speed, flexibility, mobility and economy.

GUIDED MISSILES

The New Family of Weapons

by Rear Admiral J. H. Sides, USN

Deputy to the Special Assistant to the Secretary of Defense for Guided Missiles

When one considers that the guided missile industry is only a decade in age, he is forced to the conclusion that the progress has been truly astounding. At the end of World War II, when our missile developments really began taking shape, there existed only the most meager information on supersonic flight; the turbojet was an infant; no ramjet had ever developed a margin of thrust over drag in supersonic flight; large grain solid propellantry was a new field; radars, although they had had a terrific effect on the outcome of the war, were really relatively new; the electronic industry, when viewed in the light of the present day and in the light of the demands which missiles would make was also in its infancy; and no one had a very good idea of how to design and produce a satisfactory radome. One of the most serious deterrents to satisfactory progress in the early days was the almost total lack of precise knowledge concerning the operating environment in which each component would be required to operate. This lack persisted for more years than we like to contemplate, and attempts were even made to put certain projects into limited service use before the environments were well understood. Needless to say, these attempts now represent a rather dark chapter in the history of the progress of the guided missiles.

Before becoming Deputy to the Special Assistant to the Secretary of Defense for Guided Missiles, Rear Adm. J. H. Sides spent a four-year tour as Director of Guided Missiles, Office of the Chief of Naval Operations. After this assignment, he became the first commander of the newly formed Guided Missile Cruiser Division, comprised of the *Boston*, *Canberra* and *Northampton*.

Data Recording

The most important tool for obtaining the information which we need is, of course, telemetry. A great deal of ingenious engineering has led us to advances in telemetry and now permit us to gather and analyze the important information from each flight so that we can determine how well it has been designed, how well it has been assembled, and the like. In fact, there is little doubt that the guided missile program has been primarily responsible for the great progress that has been made in telemetry; and today telemetry is used not only in guided missiles but in high performance piloted aircraft as well, and even for recording physical reactions of pilots and animals when they are subjected to extreme environments. We are now being faced with the encroachment by certain new radar systems and television systems into the assigned telemetering frequency bands, which may require us to move into other parts of the spectrum. If it becomes necessary to do this, it will require an effort and budgetary support far greater than is well understood by those not directly involved and it will take several years to accomplish it.

In the early days of missile development there was a widespread tendency to concentrate on flight testing first, in an effort to gain time, with the thought that building reliability into a missile system was something which could wait until the production, or at least the pre-production, phase. I can think of no philosophy which has had a more serious effect on our progress.

There is no magic by which reliability can be obtained. There are no tricks, no cheap ways, no easy roads. The attainment of reliability is, in the final analysis, an engineering problem which requires the last word in thoroughly coordinated engineering effort to produce a proper design, followed by production and inspection techniques which will assure translation of the results of that effort into the end product. We have learned that in order to do a proper production job, and particularly in order to facilitate test and check out, it is necessary to arrange the components in such a manner that all those of one basic variety are placed within the same section of the missile.

An Engineering Job

If we are to achieve the true reliability, there never comes a time when the design engineers can turn a job over to the production people and wash their hands of it. Reliability is an engineering job which must start at the very inception of a project and never be allowed to slacken. Any attempt to achieve it as an afterthought will result in wasted man-hours, wasted dollars, wasted range time, and many heartaches.

And now I should like to mention one aspect of reliability which is important to the user at the end of the line. It matters little to him that a missile checked out satisfactorily at the end of the assembly line, was accepted by the government inspector, and was paid for. What he is primarily concerned about is whether it will perform properly when he fires it in anger, long after the final acceptance test. He must have test and check-out equipment which will tell him quickly and accurately whether the missile is in shape to launch—and which will tell him just where to look for a troublesome component in case there is one.

With all our progress in the past decade, I'm afraid that it would only be fair to say that the guided missiles of today are, after all, only the model T's of this new family of weapons. In a way perhaps we should be concerned about the rapid rate of progress. It is somewhat discouraging to find that by the time a weapon system is fully developed and put into service use, it is almost obsolete in one sense, because of the rate of progress which has taken place in the interim. However, if one thinks this situation all the way through, he will realize that it is not our own progress which causes a weapon system to become obsolete, but rather the effectiveness of our weapon systems as compared to those of the enemy.

It was a mistake, several years ago, to look upon surface-to-surface missile systems as extensions of heavy artillery, to regard surface-to-air missiles as extensions of antiaircraft batteries, and so on. Such a philosophy was certain to confuse the issue as to responsibilities among the various Services. Guided missile systems are, in fact, new weapons systems which can and will accomplish tasks which are completely beyond the capabilities of the predecessor weapons which they will first complement and supplement, and which they will eventually, in certain cases, replace.

I hold no brief for the enthusiastic missileer who proclaims that the day is just around the corner when missiles will relegate the manned airplane to the dim distant past. Certain tasks will be taken over by missiles in the not too distant future. In other tasks, the timetable will be a much longer one. And in other tasks it may never come to pass.

I believe that surface-to-air missiles, as replacements for short range interceptors, will be the first category of guided missiles to actually take over a task, and that they will do it more effectively and more economically. But they must first demonstrate a degree of reliability and generate an acceptable confidence factor before those responsible for the defense of our Nation and of our fleets will be justified in going all the way for missiles.

In the surface-to-surface field, particularly at long ranges, the progress will inevitably follow a longer time scale. However, once the missile systems become truly operational, they will year by year assume a more important role and assume a greater and greater portion of the burdens of doing the job to be done.

In the air-to-air field guided missiles will soon be a "must", if effective air-to-air combat is to be realized. Just as modern jet airplanes have rendered anti-aircraft artillery almost obsolete, so have these same planes spelled the doom of the aircraft gun. If the long-range interceptor's armament consists of only guns and unguided rockets we shall require ground control superior to anything in sight today. And even assuming a perfect intercept there will be opportunity for only one short burst. With two six-hundred knot planes approaching each other at the rate of a mile every three seconds, even normal human reaction time will defeat us. Air-to-air missiles will greatly expand the envelope about a target from which an attack may be launched. This will take the slack out of the ground control intercept systems, and will nullify the seriousness of the human reaction time.

Long-Range Missiles

In the air to surface field, it is perfectly obvious that relatively long range missiles which can be launched from a bomber and which will complete the terminal phase of the delivery of a powerful warhead at speeds and altitudes well beyond those which can be built into the bomber itself, would represent an outstanding addition to our capabilities. In this case, the bomber and its crew need not penetrate into the zone surrounding the target which will be most heavily defended both from the ground and with fighters. The high performance of the missile and its relatively small, clean airframe will make it an extremely difficult radar target for the enemy to detect and attack. This type of weapon system should greatly increase the effectiveness of bomber forces and should prolong by several years the period when manned bombers will be effective.

Up to this point I have confined myself to rather general remarks about guided missiles and their potentialities. I believe that it will be in order to mention some

of the guided missiles weapon systems, which are now in actual operational use by our military services, as well as certain others in development.

In the surface to air field, the first land based system to become operational is the NIKE I system. This weapon system, developed and manned by the Army, possesses capabilities far beyond those of the anti-aircraft artillery battalions which they are replacing. The probability of kill against the type of attacking bombers is, in order of magnitude, greater than anything which we have had in the past. From information already published, the NIKE is a command system in which target and missile are continuously tracked by separate radars, the data from which are fed into computers which then transmit the appropriate commands to the missile so that it can successfully intercept the target.

First Operational Ship-Based System

The first ship-based system to reach operational use is the TERRIER system. TERRIER batteries are now installed in the heavy cruisers BOSTON and CANBERRA, the former of which is about to join the Sixth Fleet in the Mediterranean. In the early 1960's, the Navy should have literally dozens of surface-to-air combat ships in commission mounting not only TERRIERS but TALOS and TARTAR. The TERRIER is a beam rider; the missiles are launched into the beam of the radar which is actually tracking the target; this causes the missile to take a pursued course to intercept at which point the fuse is detonated. Any number of missiles can be fired into the same beam and sent simultaneously on their way to intercept the same target.

During the many years while NIKE I and TERRIER were being perfected, great improvements were made in radars, propulsion plants and components of all kinds. These improvements inevitably pointed the way to improved missiles of higher performance and greater capabilities. As a result, the next round of missiles to emerge from the systems already in service are the NIKE B and the TALOS, respectively. Both of these will reach out into the short-range interceptor regime and both will have the capability of carrying either normal high explosive warheads or warheads with sufficient power to sweep entire close formations of airplanes from the sky. NIKE B will soon take its place alongside the NIKE I missiles in defense of the continental United States and the Navy Cruiser *Galveston* is now undergoing conversion as the first TALOS ship.

Another missile system in this field is the Navy TARTAN. The day when it will become operational is somewhat further removed as compared to the other missiles I have discussed.

As a still longer range development, the Air Force BOMARC weapon system should result in the fulfillment of the true unmanned interceptor concept.

In the air to air field, the Navy has two systems in operational use in the fleets. Both the SPARROW I and the SIDEWINDER may now be found on board the carriers of our fleets in both the Mediterranean and the Far East. Also, the Air Force FALCON missile is taking its place as armament on certain of the interceptors now operating under the air defense command for the continental defense of the United States.

In the surface to surface field, great public interest has been created by the perhaps too much publicized intercontinental and intermediate range ballistic missile programs. These programs are going extremely well and they are on schedule. The successful integration into our national arsenal will be important. The intercontinental effort is confined to the Air Force but the intermediate range efforts will result in both land based and ship based systems which can be employed by all three Services.

Also in this surface to surface category certain weapon systems are already operational. These include the Air Force MATADOR which is already deployed in Europe; the Army CORPORAL which is likewise already deployed overseas and the Navy REGULUS which is already operational from submarines, cruisers and carriers. Important improvements are under way in all these projects which will result in quantum improvements in range and accuracy in the second generations of these missiles and their successors. All of them are capable of carrying extremely powerful warheads.

In the air to surface field the Navy PETREL missile is already operational from certain planes of the patrol plane type. The Air Force RASCAL is also well along in development for use from heavy bombers.

Conclusions

In conclusion, I should like to once more stress the importance of reliability as it affects the future of guided missiles. To me it has always been a sobering thought that what, in a piloted aircraft, might be considered a minor derangement often susceptible to adjustment and correction in flight by members of the crew, would in a guided missile be a catastrophe. This is the key reason why reliabilities which might be acceptable in most any other industry are unthinkable when we are talking guided missiles. Once we have convincingly demonstrated that we have the reliability and that we actually possess the capabilities for which the systems were designed, certain other weapon systems may be phased out with a minimum of risk and with a net saving in annual operating costs which may be measured in the billions of dollars.

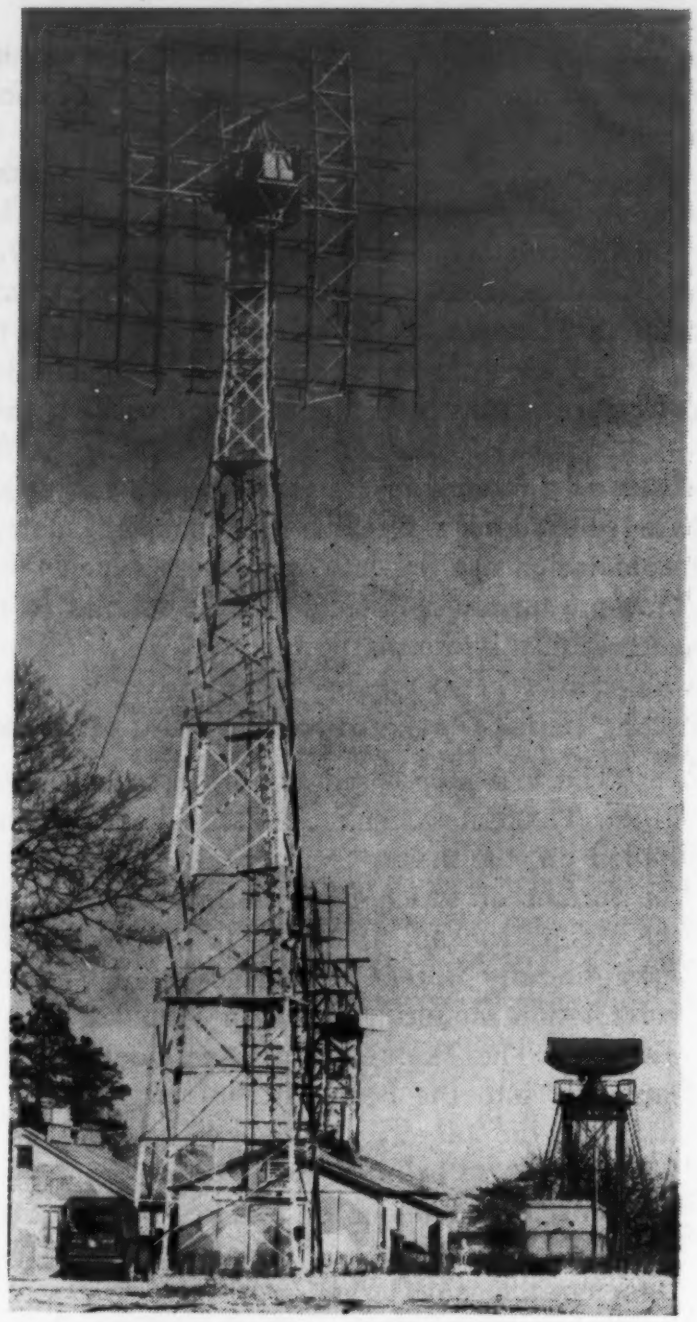
I should like also to stress the point that guided missiles are not on the verge of supplanting manned aircraft for many years to come. They are, however, supplementing and complementing those systems initially and will gradually, on a rather lengthy time scale, actually replace other weapon systems for certain tasks.

With this changing vista in armaments and weapon systems which has resulted in serious shortages of engineers and scientists, we must be extremely careful that we do not waste our talents, our efforts, and our resources by attempting to accomplish with guided missiles tasks which can be carried out more effectively by other means. We must be selective and we must ensure that we do first things first. We must not be misled by the mistaken illusion that the national treasury can pour forth limitless billions year after year for multiple projects which are designed to accomplish the same tasks on similar time scales, except in specific well considered instances.

tropospheric scatter

Meteorology's Gift to Radio Communications

By J. D. Hixson, Staff Engineer
Office of the Chief Signal Officer, USA



Antenna of Moon Radar Equipment

WITH THE MAGIC OF SCIENCE AND the wonders of nature, man's ingenuity has made available a new and useful vehicle of communication known as tropospheric scatter.

Scatter—the dominant word in radio communications today—is aptly termed. As the word implies, the radio signal is literally scattered by elements of the atmosphere in a region designated as the troposphere. The troposphere is that part of the atmosphere up to approximately five miles above the earth's surface. It is here that a phenomenon of nature produces a condition that causes the radio waves to refract or "scatter." Another form of scatter exists in the lower ionosphere, but that is another story and will be discussed here only to clarify the story of tropospheric scatter. For better understanding of the action that the radio waves experience, scattering may be likened to the scattering or dispersion of light from a car's headlights on a foggy night.

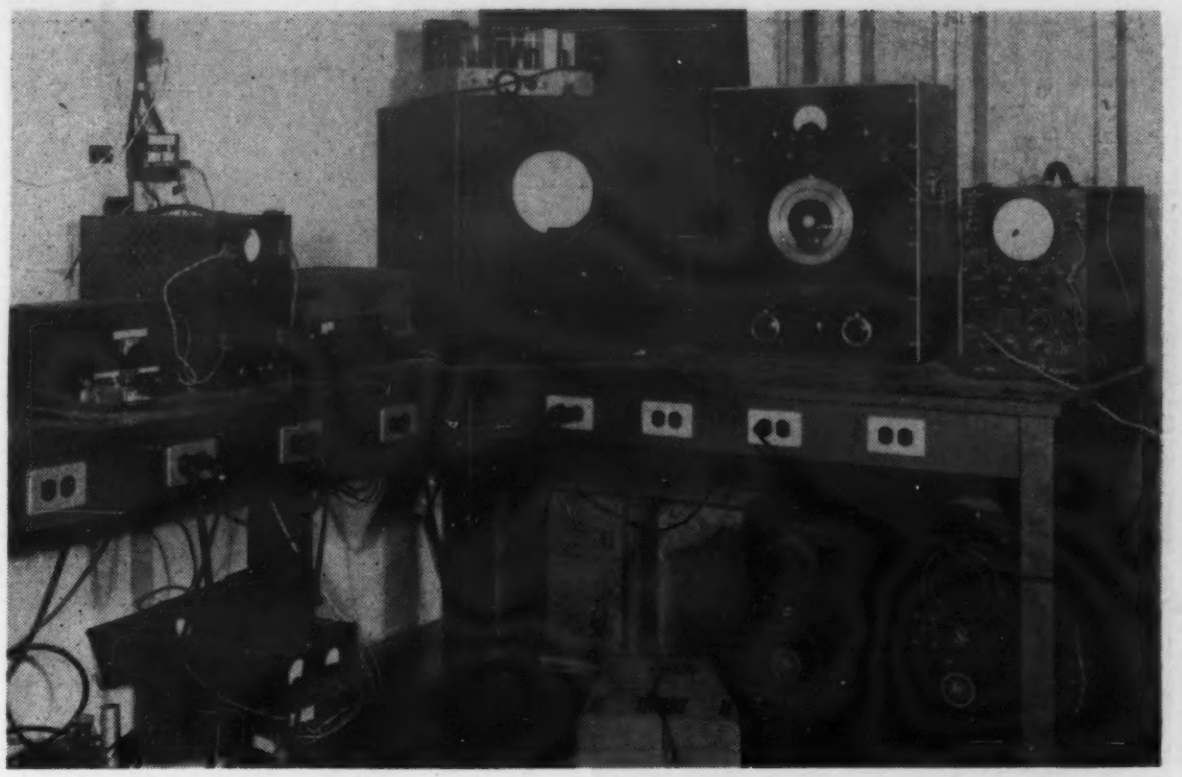
Scatter propagation is the combination of high and low level diffraction to produce signals beyond the horizon. The diffraction field is an area beyond the horizon where the signals are bent earthward purely by diffraction. Greater range is realized by high level diffraction, or scattering, within the troposphere.

A Standard Atmosphere

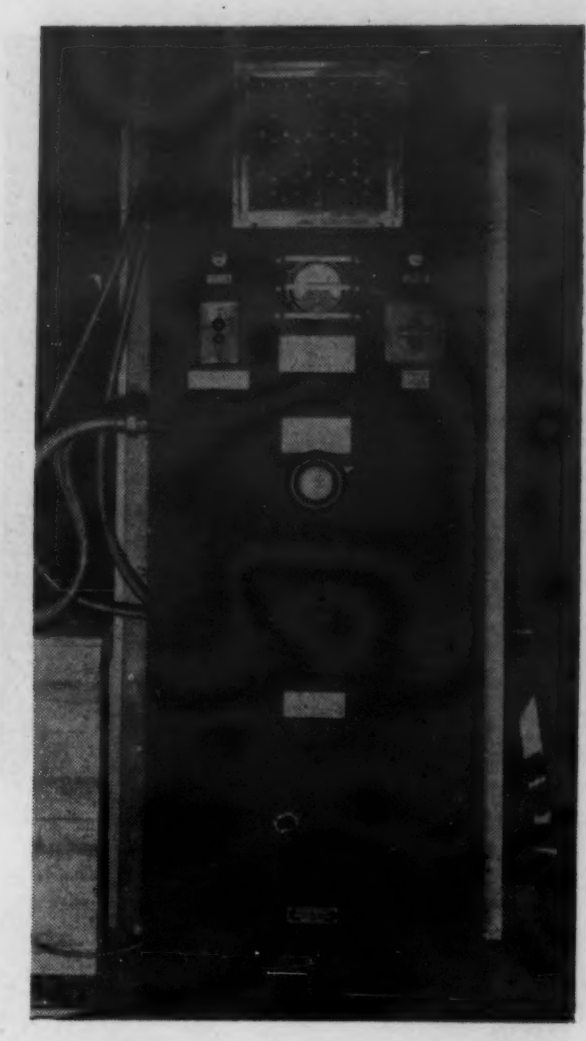
Optical illusions, such as the refraction of light rays, are due to atmospheric conditions and have been known for some time. Yet it was not until 1930 that Jourust showed the significance of atmospheric refraction in radio wave propagation. The effects of the meteorological elements of atmospheric temperature, pressure, etc., are measured and combined by formula to provide, in a common term, refractive index.

The atmosphere is not a stable body. If we assume a standard atmosphere where the refractive index decreases uniformly with height, the effect on a radio signal is nil. But if the condition of the atmosphere is super-standard the effect on a radio signal would be to bend the radio wave earthward. Consequently, the range of the signal is extended beyond the normal line of sight. And at the other extreme, meteorological conditions may exist in the atmosphere to produce a sub-standard condition where the effect on the radio signal is to bend the radio wave skyward and be lost to earth surface reception.

The standard atmosphere is not a normal condition; it is the ideal, and is used primarily as a reference. A transitional condition of the atmosphere is nearly always prevalent in some form at some altitude. Fortunately, the sub-standard condition is not frequently experienced, at least not at very low levels of the atmosphere. The ability of this meteorological phenomenon to influence the path of a radio signal and thereby to produce scatter is not dependent upon the fluctuation of the refractive index only, but also upon the wavelength of the radio signal. Prior to 1930, it was a popular belief that



Controls, synchronizing and indicating equipments for "Moon Radar Project"



Transmitter of radar set used for "Moon Radar Project"

radio signals above 30 megacycles penetrated the atmosphere and were lost for all practical purposes beyond the horizon.

The ionosphere is the predominant influencing factor in propagation below 30 megacycles. Reflection of a radio signal from the ionosphere shown as normal reflection consequently has great range capabilities. In the lower ionosphere the phenomenon of ionospheric scattering occurs. The relationship of tropospheric scatter to the other modes in effective distance and mechanics of propagation is also shown.

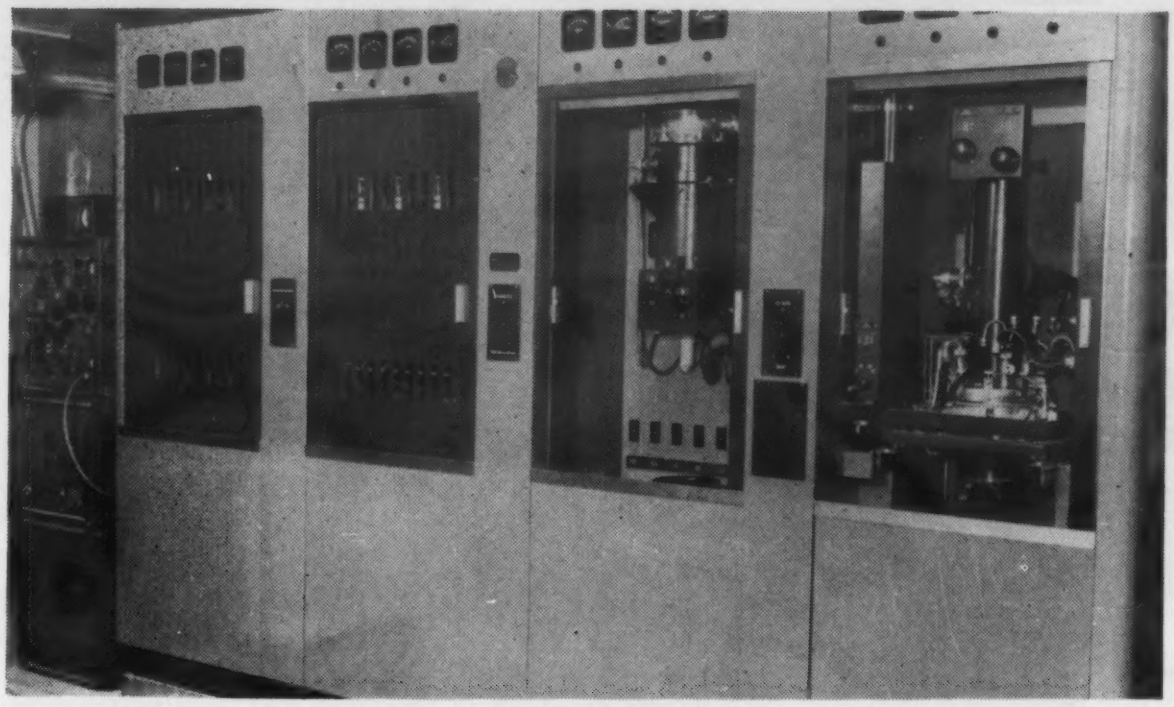
Development of Radar

By 1934, industry and military establishments recognized great potentialities in the scatter phenomenon. Before World War II the use of radio frequency above 30 megacycles was not much more than a toy for amateur radio operators, and a topic for scientific discourse. With the advent of World War II, new equipment development in the higher frequency range with more power, and receiving equipments having greater sensitivity made possible the beginning of controlled experiments of this new mode of propagation.

The development of radar was probably the largest stepping stone in the advance of tropospheric scatter communications since radar accuracy and range are a function of the frequency and power. Advancement in these features was accelerated due to the war effort. Radar operators in the beginning were amazed to find echoes being received from apparently nothing. This, the so called "Angel," is a condition resulting from a meteorological phenomena, which causes the radio wave to be reflected, or back-scattered, to the receiver. The

(*Continued on page* 25)

Shown above is the assembly of antenna, mount and tower of the Diana Radar System for use in very long-range radio propagation



Power amplifier required for tropospheric scatter

Assembled above is terminal equipment, telephone AN/TCC-7 and radio terminal set AN/TRC-35

classic case is that of a reader operator in the South Pacific who observed echoes at a range of 1,500 miles while operating a 200 megacycle radar.

The Navy during this time was exploring the VHF (30 to 300 megacycles) and UHF (300 to 3,000 megacycles) radio bands for "ducting." Ducting is a phenomenon occurring in the atmosphere which produces an elevated boundary *or* boundaries for the radio wave to be conducted over distances greater than normal. This condition, predominant over coastlines and water, is produced by a complex form of non-standard atmosphere. The results of these experiments led to the first organized study in tropospheric scatter. By 1950, the now famous Booker-Gordon Theory was evolved. This theory satisfied the experimental results and provided quantitative values to the phenomenon of tropospheric scattering of radio waves, paving the way for scientifically engineered experiments.

With a working theory and the instrumentation to develop tropospheric scatter as a system, effort was redirected toward expanding a sister mode, ionospheric scatter. The ionosphere is a region of our atmosphere approximately 100 miles above the surface of the earth. It is then axiomatic that ionospheric scatter has greater range than tropospheric scatter. Further, the frequency of operation being different from that of tropospheric scatter, ionospheric scatter is realized up to approximately 100 megacycles whereas tropospheric scatter extends well into the gigacycles (thousands of megacycles). And, by nature, the phenomenon of tropospheric scatter requires a large amount of power and range from the ultra thru the super high frequencies to be effective. For these reasons progress was more rapid in ionospheric scatter than for its predecessor, tropospheric scatter. For the extreme ranges of the tropospheric scatter mode, a tremendous amount of power will be required. For this reason, it is optimistic to expect high reliability and multi-channel capacity circuits for ranges greater than 400 miles in the near future.

The Army has supported and is continuing to support research and development in both tropospheric and ionospheric scatter mode propagation. The advancement of these modes has left in their wake other new and promising modes of propagation.

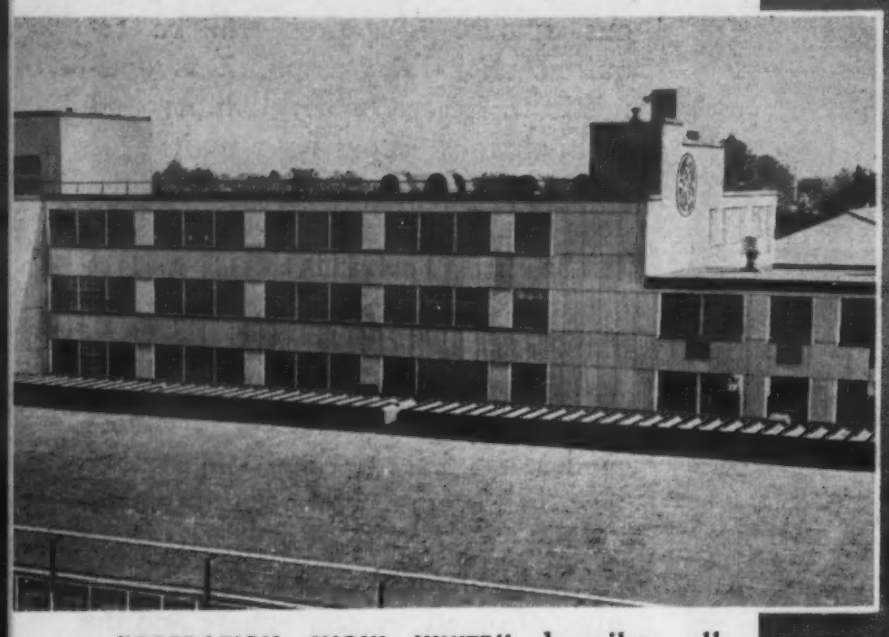
To better understand the mechanism of the upper atmosphere and the part it plays in the propagation of electromagnetic waves, the Army Signal Corps set up an experimental high power radar to probe the atmosphere, utilizing a technique of reflecting a radio signal from the moon, to measure and study the atmospheric effects upon the transmitted radio signal.

Army Advances Research

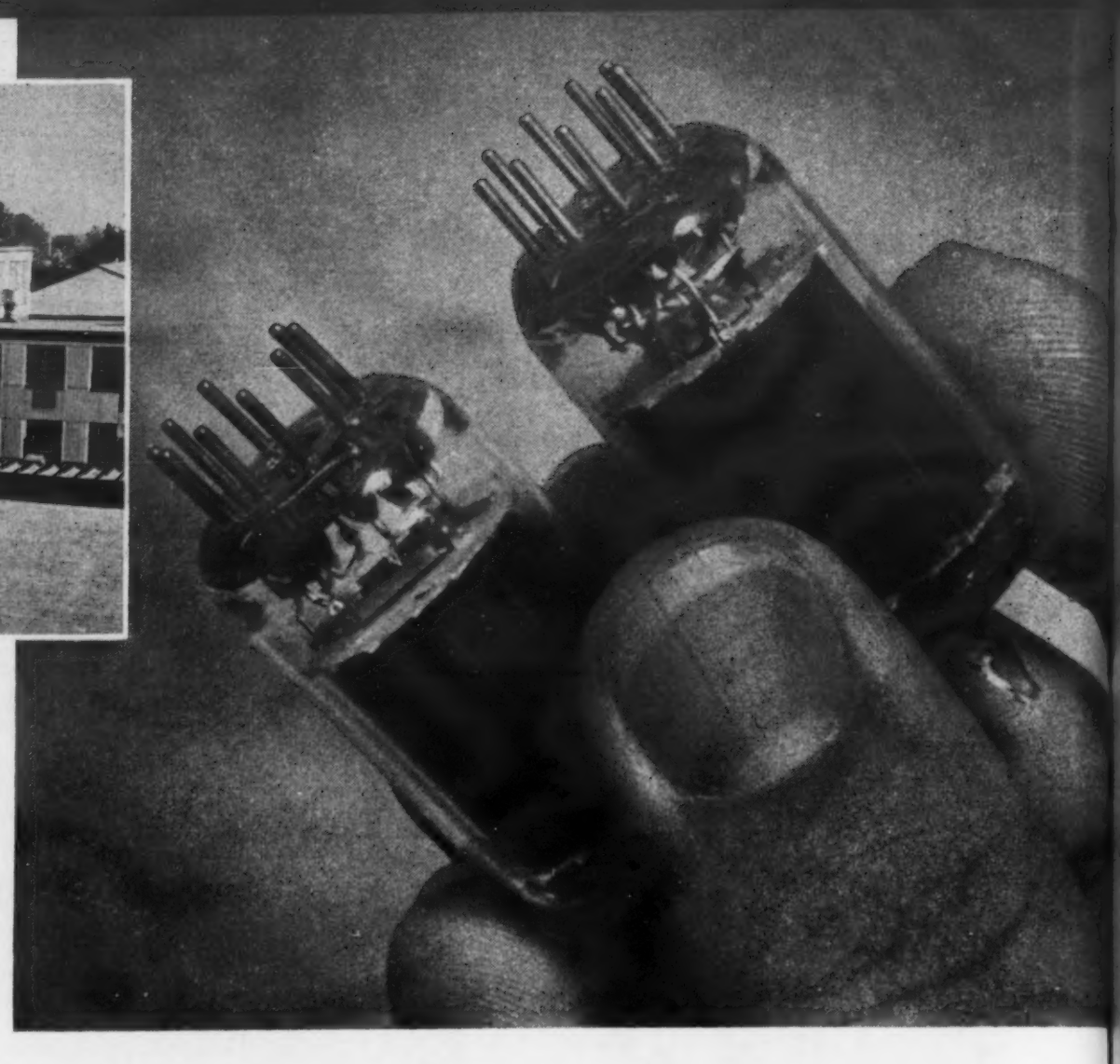
The Army has contracted with academic and commercial institutions, and has supported the work of the National Bureau of Standard's Central Radio Propagation Laboratory in scientific research, to advance the science of tropospheric scatter mode propagation. The Army is still engaged in extensive internal research and development within the Signal Corps Engineering Laboratories. The results of all this research have led to the development of tropospheric scatter communication equipments for the Army.

In tropospheric scatter, the future holds much for our way of life and for the world of communication. The extention of the useful radio frequency band will relieve an overly crowded UHF and VHF band and permit the utilization of stations employing greater bandwidth.

Television service areas will be extended without use of radio relay links, which in some instances might be difficult and costly to install. The Army has nurtured the research and development of tropospheric scatter as a mode of radio propagation. The investment has been rewarding and the future is bright. The ultimate evaluation, however, must await the development of instrumentation in the higher frequencies and greater power.



"OPERATION SNOW WHITE" describes all manufacturing in General Electric's separate large factory building at Owensboro, Ky., where 5-Star and other military tubes are built. Hospital cleanliness applies throughout. Premises are air-conditioned and pressurized to keep out dust or dirt that can cause inter-element shorts. All employees wear lint-free Nylon or Dacron garments.



TUBE PINS before and after cleaning. This ▶ is an unretouched photograph.

General Electric "Sand-Blasts" military tube pins for better electrical contact, added reliability!

General Electric military tube pins are "sand-blasted" clean, further extending the Snow White program of impurity-free manufacture. Miniature tube stem-making and bulb-sealing require high temperatures that leave oxidation on the pins. The special pin-cleaning process developed by General Electric scours all oxidation from pin surfaces, assuring efficient socket contact.

Twin guns force streams of abrasive emulsion over the pins. The abrasive scrubs off all non-conductive material and the pins then are rinsed in clear water and dried by infrared lamp. When a tube is plugged in, electrical contact is complete and lasting.

Abrasive cleaning of pins is only one step in General Electric's extensive Snow White program to produce high-reliability tubes for military applications. Tube parts are precision-made, and the tubes assembled and inspected, under immaculate conditions which ban any impurities that might cause early-life failures or unstable electrical performance. Snow White cleanliness is a principal reason why 5-Star and other General Electric military tubes have the dependability and long life so vital in critical sockets.

Ask for G-E high-reliability tubes—5-Star or other military types—in new electronic equipment! Replace with them in equipment now on hand! *Electronic Components Division, General Electric Co., Schenectady 5, New York.*

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— GOVERNMENT —

CONTRACT FOR FAIRCHILD ENGINE The Engine Division of Fairchild Engine & Airplane Corp. has announced receipt of orders and firm contract commitments amounting to approximately $7 million for the fabrication of major components of a new large jet engine now being made in quantity for the military service.

IMPROVED "TRAFFIC COP" An improved electronic "traffic cop" that prevents unwanted frequencies from interfering with the operation of radio equipment has been developed by Federal Telecommunications Laboratories, Nutley, New Jersey. This device, known as a magnetostriction filter, is expected to find many applications in radio and radio-telephony. It shows marked improvement over older models in size, operation and cost.

TURBO-PROP TRANSPORT AIRCRAFT The first turbo-prop transport aircraft to be used by the United States Air Force, the Lockheed C-130 Hercules, is designed to carry 20 tons of equipment or airlift 90 combat-ready troops, and make delivery by parachute or landing. It can also be set up to air evacuate 70 injured on stretchers along with medical attendants. The new prop-jet aircraft is designed to fly higher, faster, and more economically than any existing military transport and is scheduled to replace the present medium troop carrier aircraft, the C-119 Flying Boxcar.

NEW INJECTION SEATS TO INCREASE SAFETY MARGIN FOR NAVAL PILOTS The Department of the Navy recently announced that it has embarked on a program to install "ground level" ejection seats in all present and future applicable naval aircraft, increasing the margin of safety afforded pilots beyond anything ever before realized in the history of U. S. Naval aviation. A spectacular demonstration was made by the Martin-Baker Co. at a Farnsborough Air Show in England, in which a live subject was recovered from an aircraft traveling 125 miles per hour with wheels still on the ground during takeoff. This proved the feasibility of providing ground-level escape capability in the low altitude escape program then under investigation by the Navy.

HOLTZ NAMED ASSOCIATE GENERAL COUNSEL The Federal Communications Commission has announced the appointment of Edgar W. Holtz as Associate General Counsel. His former position was that of Assistant Chief of FCC's Office and Opinions and Review. Before joining the Commission in 1955, Mr. Holtz was Assistant City Solicitor of Cincinnati, and, in that same city, served as general counsel for WCET, the first educational TV station to be licensed.

NEW COMMUNICATIONS LINK William G. Thompson, assistant vice president of American Telephone and Telegraph Company, presided, as the U. S. Signal Corps and the Bell Telephone System opened to public service on December 11, 1956, a new and important communications link between the United States and the growing Territory of Alaska. The link consists of an underwater telephone cable system stretching some 1,270 miles from Port Angeles, Wash., to Skagway, Alaska. The inaugural call was made by Hatfield Chilson, Assistant Secretary of Interior and B. Frank Heintzleman, Governor of Alaska. At each location, Government, military and industry officials participated in the ceremonies.

— INDUSTRY —

G-E AUTOMATIC PROGRAM CONTROL SYSTEM FOR TV Elmira, N. Y.'s UHF television station WSYE-TV is the nation's first to adopt the General Electric program control system developed to assure television viewers more accurate programming with a minimum of "blank screen time." The program-control system automatically schedules all switching necessary for programming slides, films, network, and audio. Thus, the normal routine of television station breaks, commercials, and succeeding programs is continued without pause or interruptions. A maximum of seven pieces of equipment can be controlled, such as two motion picture projectors, a slide projector, a station-identification projector, network and audio tape.

ATOMIC CENTER FOR RESEARCH A new corporation will be organized as a jointly-owned company by Sylvania Electric Products, Inc. and Corning Glass Works to expand research and production in the atomic energy field. The center will concentrate on the development and production of nuclear fuel elements and components, and is expected to be one of the outstanding facilities of its type in the world.

INFRARED MONOCHROMATOR The Servo Corporation of America, New Hyde Park, N. Y. has developed an airborne infrared radiation laboratory for infrared analysis of airborne targets, known as the Infrared Monochromator. The device detects, analyzes, and records information about missiles and jet aircraft by their exhaust gasses and skin temperature heat radiations.

RADIO-TRANSMITTER-RECEIVERS A radio, about the size of a cigar box, said to send and receive over a 30-mile range, has been developed by the Avco Manufacturing Corp. The transistorized unit is housed in a glass fibre case which will stand any kind of abuse. The company envisions demand for the set by the military, heavy construction concerns, radio stations, and newspapers among others.

NEW MEMORY DEVICE Development of a new type of memory device by Dr. Jan A. Rejchman, RCA scientist, may pave the way for smaller, more efficient electronic computers. The device, RCA claims, can store a million bits of information in space little larger than a shoe box. It lends itself to extremely simple molding production techniques and offers substantially greater simplicity of operation and maintenance.

FLIGHT CONTROL SYSTEM Lear, Inc. recently was given permission by the USAF to disclose that the flight control system for Lockheed's X-7 missile, a supersonic ramjet-powered test vehicle, has been supplied by Lear since inception of the project in 1949. After launching from a B-29, and after being accelerated to ramjet operating speed by rocket, this missile performs its prescribed test mission and is then decelerated and recovered by parachutes. After servicing, it is ready for another flight. Thus the missile's flight control system not only had to meet Lockheed and Air Force requirements for control at high altitudes and speeds, but also had to withstand the severe shocks of repeated recoveries without damage.

— GENERAL —

ROCKET SPEEDS IN EXCESS OF LIGHT PREDICTED The Air Force is interested in testing the new atomic theory of a Navy scientist which, if valid, could lead to speeds of 186,324 miles per second, the speed of light, or more. Claims are strictly unofficial but basically the theory states that as the atom gets colder it becomes less active. Electrons in the cold atom structure tend to gravitate towards the atom nucleus at ever increasing speeds. If the atom can be made cold enough, the electrons will plunge into the nucleus of the atom causing a nuclear reaction which would release the entire energy of the nucleus. This theory defies two present theories now held as postulates: that 459.6 degrees below zero Fahrenheit is absolute zero, and that the speed of light is the highest speed obtainable.

RADIO ASTRONOMY OBSERVATORY The National Science Foundation has entered into a contract with Associated Universities, Inc., to conduct basic research activities in the field of radio astronomy. The contract provides for establishment of a radio astronomy observatory at Green Bank, Pocahontas County, West Virginia. Under terms of the contract, AUI will construct the facility and provide for the "management, operation and maintenance of the observatory with the primary purpose of making its facilities available for visiting scientists." The Foundation will obligate $4 million to finance the program. Included in the equipment will be a precision radio telescope with a diameter of approximately 140 feet.

INTERNATIONAL CONFERENCE ON SCIENTIFIC INFORMATION The National Science Foundation, the National Academy of Sciences—National Research Council, and the American Documentation Institute recently announced joint sponsorship of an International Conference on Scientific Information to provide for a thorough discussion of present developments and research pertaining to the organization and dissemination of scientific information with special emphasis on storage and retrospective search. The conference will be held in Washington, D. C. early in November, 1958. The objective is to attempt to overcome mounting difficulties in scientific communication resulting from the increasing tempo of research activity and the ensuing flood of scientific publications.

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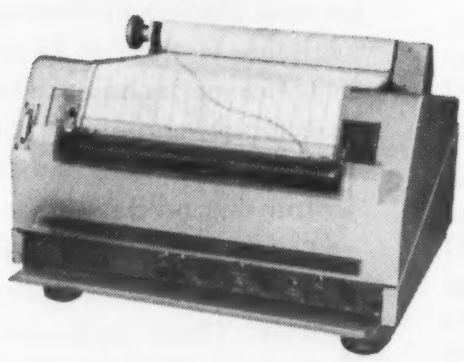

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What Price FREQUENCIES?

By Major General Alvin L. Pachynski, USAF

DIRECTOR OF COMMUNICATIONS-ELECTRONICS

U. S. AIR FORCE

WE HEAR A GREAT DEAL TODAY CONCERNING THE resources the Air Force needs to meet its obligations to national security. At the forefront is the public interest in Air Force weapons. But less publicized is the requirement for the material, other than air weapons, which permits the capabilities of such weapons to be fully exploited. Communications-electronics equipment constitutes a major element of such material. Last but not least, the Air Force as an entity is not complete without personnel—a vital segment of our resources.

The Air Force we have today and what we are able to provide for tomorrow, in terms of these resources, is dependent in large part on the size of the appropriations the Nation sees fit to make available. For it is money that largely determines our progress in research and development, the degree to which we can maintain an inventory of modern weapons, and the material required to support them. It is also money that determines our personnel ceilings and, to a significant degree, the quality of our manning.

The Author

General Pachynski graduated from the United States Military Academy in 1927 and was first assigned to the Army Signal Corps. During World War II, he was Signal Officer for the Fifth Air Force in the Southwest Pacific Area, and Communications Officer for the Far East Forces. In June of 1956, he became Director of C-E at Air Force Headquarters. General Pachynski is a National Vice President of the AFCEA.

Increased appropriations, of course, generate additional problems. They increase the variety and complexity of new material brought into the inventory. In the communications-electronics area, greater complexity of our gear requires us to focus our attention on the problem of reliability. Today there is seldom a meeting of industry and military representatives where some aspect of reliability is not given emphasis in the discussions. Obviously a high degree of reliability of communications and electronics gear is essential if it is to fulfill its role within the scheme of Air Force operations.

Currently, in Air Force-Industry relations, growing emphasis is being placed on the subject of maintainability. The increasing variety and complexity of communications-electronics equipment and systems required to meet the demands of today's and tomorrow's operations is placing an increasing burden upon the manpower available to the Air Force to maintain it. The limitations in terms of technical skills available make it mandatory that as new communications-electronics gear is developed, it is so designed that it can be effectively maintained within our military organization with the skills available.

These and other problem areas within the Air Force can be licked—for the most part—given the money required. There is, however, one resource essential to our operations, not procurable through appropriations. In fact it is a resource that has no tangible value, yet is invaluable. The Air Force would be completely immobilized without it. I have chosen, therefore, as my topic a subject encompassing this resource, the Air Force needs

involving it, and the roles of the Air Force and of industry in providing for its optimum utilization. The resource I am referring to is the radio frequency spectrum.

Pertinent to any consideration of current radio spectrum usage, I believe, is a chronological review of how we arrived at where we are.

Five years after Marconi bridged the Atlantic in 1901 with his epoch-making wireless signal, the first international radio conference was held at Berlin. This conference agreed on international use of two discrete frequencies—500 and 1,000 kilocycles—for ship-shore radiotelegraphy. I say "discrete" advisedly, for compared with today's allowable tolerance in use of the radio spectrum, the radio transmission typical of those days hardly could be referred to as occupying "discrete" portions of the spectrum.

The next conference in 1912 at London was the first to deal with a complete segment of the spectrum, providing for use of the band 150 to 1,000 kilocycles. The Washington Radio Conference of 1927 extended the recognized international usage of the spectrum down to ten kilocycles and upward to 23,000 Kc, which was further extended by the Madrid Radio Conference in 1932 and the Cairo Conference in 1938 to 30,000 kilocycles. Finally in 1947, the Atlantic City Radio Conference provided for internationally agreed allocated use of the spectrum to 10,500 megacycles. The allocations currently published by the Federal Communications Commission envisage present and potential national use of the electromagnetic spectrum to 30,000 megacycles and above.

Spectrum Space

You will note that the agreements reached at the international level covered progressive extension in the use of the spectrum which paralleled, generally, progress in the state of the art. The greatest progress followed each of the two world wars. New techniques, particularly in vacuum tube development during World War I, were responsible for exploitation of the high frequency portion of the spectrum. It is true that almost until the end of the 1920's, only the amateurs recognized the propagation potentialities of high frequency communication. When the amateurs, however, confirmed the economical and technical usefulness of long-range, high frequency communication, there was a scramble to adopt this technique for international communications.

The rapid expansion of high frequency networks to meet national and international telecommunications needs during the period between the two world wars constituted no great problem. The supply, in terms of spectrum space, was more than adequate to meet the demand.

By the time of the Atlantic City Radio Conference of 1947, however, the situation had changed. For the first time, this conference had to cope with problems involving the accommodation in the high frequency portion of the radio spectrum, of not only established services with greatly expanded requirements, but also of new services such as aeronautical point-to-point and air-to-ground. World War II brought about a burgeoning electronics technology which demanded a place in the spectrum for many new techniques applied to civilian as well as military use, such as television and radar. World War II had already demonstrated that in the high frequency portion of the spectrum, at least, there appeared to be a finite limit to the number and density of services that could be accommodated. This experience was sufficient to put the nations of the world participating in the conference on the alert with regard to anticipating similar conditions in other portions of the spectrum not yet exploited. The competition not only between nations but also between interests representing different types of services to obtain rights in the spectrum was intense. The conference resulted in compromises which really failed to fully satisfy any of the participants. The provisions made for the U.S. Military Services at the time, and in subsequent regional and U.S. allocations, appeared to reasonably satisfy military requirements. But these allocations were based on a U.S. position which assumed a protracted period of genuine peace, with military forces primarily committed to progressively decreasing occupation functions following World War II.

The Cold War Impetus

The cold war, beginning in 1948, changed all this. The United States found it necessary to reverse its field and to start rebuilding its forces to provide for a military posture more in keeping with the suddenly apparent menace. Korea gave added impetus to this trend. The Air Force found itself placed at the forefront of the effort to establish a proper U.S. military posture. Recognized was the fact that the Nation needed a strong strategic air force and an effective air defense if the national security was to be maintained in the face of the known threat.

The adequacy and effectiveness of an air force is measured in terms of providing not only superior weapons but, technically, the means required to fully exploit the capabilities of those weapons. Air Force communications and electronic equipments and systems must keep pace with these requirements. As the speed and range and fire power of our weapons increase, so do the complexity and scope of our communications and electronic equipments and systems.

SAGE: Case in Point

A case in point is SAGE, the Semi-Automatic Ground Environment system required for an effective air defense of the United States. The operating concept of SAGE calls for a marked increase in the number of UHF frequencies required for the operation and control of weapons in this new electronic ground environment. As our advancing technology gives us new tools to fulfill the Nation's security requirements, it concurrently increases the problems of providing the required operating space in the frequency spectrum.

Concurrently with the build-up and modernization of U.S. Military forces, there has been a steadily accelerating and apparently insatiable demand and application to use in the civilian economy of new communications-electronics devices and systems also requiring space in the radio spectrum.

Until recently, the effort to absorb this output of our technology within the frequency spectrum has been confined chiefly to accommodation within the established

table of frequency allocations. The increasing variety and density of existing and new services, such as broadcasting, international and domestic fixed, aeronautical, mobile, public safety, industrial, Government and amateur—to name a few—are such that no one service is entirely satisfied with the spectrum space allocated to it. As each becomes more firmly established in its allocated frequency band, the greater its proprietary interest in the band because of the economic investment made. Hence, decisions to transfer or readjust allocations between classes of service become increasingly more difficult as time passes.

Forward Scatter

This brings us to another problem area. The Atlantic City Radio Convention of 1947 was the first to recognize the usefulness of the spectrum above 27,500 kilocycles. In providing for the services to be established therein, through allocations, the assumption was made that frequencies in the VHF and higher portions of the spectrum were useful to those services where the line-of-sight propagation characteristics of such frequencies were applicable. Obviously, this meant short-range, local operation as distinguished from the long-range characteristics of radio frequency propagation below about 30 megacycles. But continued research in propagation developed the existence of a phenomenon referred to as forward scatter, or over-the-horizon transmission, in which the higher frequencies apparently could be used for communication at much longer ranges than former theories visualized possible. The Air Force has since proved the soundness of these findings through extensive operation of both forward ionospheric and tropospheric scatter circuitry. This is a new technique which was unheard of in 1947. The carefully arranged Table of Allocations established at that time makes no provision for it. To what degree, for what purposes, and how is it to be accommodated in the spectrum?

Problems of Policy

The point of all this is that, in my opinion, the time is coming—if it is not already here—when the health of our communications-electronics community will be determined in large part, not by the amount and variety of devices and equipment that the Nation's economy can absorb, but by the availability of frequencies in the radio spectrum.

The Air Force has a big stake in the frequency spectrum. Our appropriations for communications-electronics probably total two-thirds or more of the Department of Defense budget for this area. Contrary to the concept visualized by the average man-on-the-street, the closer we approach the pushbutton era of warfare, the more complicated will be the organization of men and material behind the pushbutton. But the real rub is in the fact that the bulk of the equipment we buy must be put into immediate operational use and not into mobilization storage as it was before in past wars. As our inventory of communications-electronics equipment increases, so does the demand for radio frequencies. Obviously, the demand is in competition with the increasing demands of a civilian economy that is growing by leaps and bounds. What can be done to solve this problem?

In my judgment, there is no lasting solution to the problem if, by a solution, we mean trying to satisfy everyone who visualizes a use for space in the radio spectrum. The first element leading to a solution lies, therefore, in the sphere of policy. It involves an examination at the national level of requirements of what is important and what is unimportant relative to the national interest. Such an examination can only be made by policy-making officials who have the responsibility for the Nation's political, economic, social, and cultural welfare and for the national security. It should take cognizance of current and anticipated technological capabilities. Since it must be implemented by the national technical frequency management organization, this policy should be clearly stated.

The subject of policy, however, in so far as the purpose of this article is concerned, is of secondary interest.

Any national policy formulated must be complemented by a combined and conscious effort on the part of the user and the producer of communications-electronics equipment to conserve radio frequency spectrum space. This effort must be aimed at satisfying (through technological achievements) the requirements validated by the national policy.

Frequency Conservation

An element of this effort should be aimed at integrating as many related operational functions as possible into a single system. This will require more forward thinking and planning than has been accomplished in the past. We have reached the point now in our weapons systems where a separate black box for each operational function becomes very costly to our weapons' performances. In the past we have accepted the separate black boxes because of economic costs of equipment. Fully integrated electronics systems, however, are the order of the day for our new and modern aircraft.

In one sense it is fortunate, perhaps, that our technology is accelerating the obsolescence rate of much equipment in our inventory. But the integration of operational functions cannot be carried out over night. In military and civil aviation, it involves replacement of equipment not only in the aircraft, but in the supporting ground environment which represents a tremendous dollar investment. We are making progress. The impelling motive behind our present efforts to integrate functions has not, however, been the need for frequency conservation but more effective operations in a jet age. *Fortunately, the objective of frequency conservation is for the most part compatible with the technological effort currently being made to integrate functions. From the long-term standpoint, this should pay dividends.*

The present trend toward modular construction of equipment, particularly in aircraft, should likewise pay dividends in the effort to conserve frequencies.

As new techniques aimed specifically at reducing the space occupied in the spectrum are developed, particularly in the field of modulation, we should have a capability to incorporate such new techniques through exchange of component assemblies, rather than replace-

ment of complete installations which represent a high dollar investment.

This brings me to some specifics in the area. The amount of space occupied in the radio spectrum by any class of service, be it military or civil, is governed largely by the operating characteristics of radio transmitters. As an example, we have in the Air Force inventory today UHF air-ground communications equipment theoretically capable of operating on any of 1750 channels spaced at 100 kilocycles. *But in practice, we can derive only a fraction of that many channels for reliable operation. The reason is that we must cluster—to meet our operational requirements—as many as twenty or twenty-five channels within one geographical locality.* The equipment we have does not technically lend itself to operating in adjacent 100 kilocycle channels in such close physical proximity. Factors such as transmitter stability, image rejection, spurious response, receiver selectivity, and radiated harmonics preclude such utilization of frequencies. Spacing of several hundred kilocycles or more is often required. To the uninformed, this might appear to be a prodigal use of the spectrum. It is not unique. It is typical of all equipment, whether used for military or civil purposes. Our UHF equipment is the best the state of the art could produce, but it serves to point up another area in which our technology can help in conserving spectrum space.

Greater Initiative by Industry

Defense requirements laid on the communications and electronics industries can be credited, I believe, for promoting the development of many techniques looking to greater reliability and flexibility in operations. These include such technical criteria as transmitter stability, receiver selectivity, spurious and harmonic radiation, and new modulation techniques. Sometimes industry has been hard pressed to meet these criteria. On the civil side, the Federal Communications Commission has set the standards. FCC standards have frequently been established only after consultation with the agreement by industry. Thus industry has, in many instances, followed rather than led on the adoption of new tolerances applicable to use of the frequency spectrum. Admittedly, the tolerances have been set only after a reconciliation of both state of the art capabilities and the economics involved in marketing equipment. *But I do not believe that there has been any really impelling motive to advance the state of the art specifically for the purpose of conserving radio frequencies; and it is entirely possible that costs of producing the equipment required to preserve a market in the future may have to be given less weight.*

An important step forward to alleviating our growing frequency congestion appears to be for industry itself to assume greater initiative in this area.

International Geophysical Year

As you know, some forty-five nations have joined in a common effort called the International Geophysical Year 1957-1958. This takes place at the cyclic peak of solar activity. It is possible that this concerted research effort will uncover new uses for the radio spectrum not presently visualized or permit certain classes of service now allocated frequencies in the congested portions to be accommodated in presently unused segments.
Like our experience with forward scatter, we cannot be entirely certain that what we know about propagation today will apply to an evaluation and determination of spectrum usage tomorrow.

Modulation Techniques

Finally, I would like to dwell for a moment on modulation techniques and the application of information theory. The integration of functions involving the consolidation of several sources of information into one channel, utilizing a single frequency assignment, is not achieved without cost in terms of band width—or frequency spectrum usage. During World War II, teletype—as a means of communications—satisfied our needs. Since then the concept of our operations has progressively changed with improvements in weapons capabilities. We have requirements today not only for multi-band teletype, but for voice, facsimile, data transmission, photo, and even television. Like all users of the radio frequency spectrum, the Air Force is confronted with the problem of finding the space required to accommodate these wider band transmissions. Our technology, whether as a result of conscious application of information theory, or otherwise, has made progress in packing more information into a given bandwidth. Perhaps the most dramatic proof of this is in the new National Television System Committee color television standard. Color television, based on the obvious technique would require three times the bandspread of the 4.5 megacycle black and white television. The NTSC action, in spacing the color information in unused space between side bands of the black and white signal, permitted the established channel assignment to be used without change. Yet television broadcasting, as such, is still an expensive service when measured in terms of the six megacycle channel spacing it now requires. This is one of the areas where further application of information theory could pay great dividends from the standpoint of frequency conservation.

No Immediate Solution

What I have said to you about radio frequencies has served merely to outline the problem and the possible steps leading to its solution. There are complexities involved which must be studied in great and time-consuming detail by competent people. No hasty solution is possible. Certainly no immediate solution can be achieved. The factors involved (not the least of which is the economic one) are such that there can be no immediate and wholesale reallocation of spectrum space. Rather, the solution lies in the establishment of long term objectives rooted in technological progress and which, among other things, must take equipment obsolescence into account. The successful achievement of those long term goals is dependent on a joint awareness by all of us of the problem that exists today. If we recognize today that it does exist and work jointly toward a solution, radio frequencies tomorrow may still be procurable at a reasonable cost.

in Defense of INDUSTRY

by **WILLIAM E. HAINES**

Director of Industrial Defense
Business and Defense Services Administration
Department of Commerce

An address given to the Lexington Chapter of the AFCEA

IT IS DIFFICULT, PERHAPS IMPOSSIBLE, for most of us to visualize the destructive power of a ton of TNT. Yet, only a few short years ago the world began to measure the power of explosives in thousands of tons of TNT—kilotons. Now, even the kiloton yardstick is too short, so we must resort to the megaton—the million-ton equivalent of a ton of TNT. To say that this latest measurement of death dealing power is almost beyond man's comprehension is but to explain the obvious.

Just as the power of modern weapons has increased with fantastic speed, so have the problems involved in even attempting to deal with their awesome consequences. Living as we do in an age of danger we must try, somehow, to prepare against a day which we fervently hope—and pray—will never come. We can hope that no man will ever pervert the atom's use to the destruction of civilization. Yet, we must not, we dare not, live by that hope alone.

We are compelled by circumstance to maintain what is often called a "posture of readiness." Now just what is a posture of readiness? Does it mean that we shall build the most powerful weapons, perfect the most efficient methods for effecting their delivery, and devise a network of defense to prevent or frustrate the strategic and tactical efforts of an aggressor? Clearly, these things are not enough.

Megation Weapon Brings New Dimension

The coming of the megaton weapon has brought with it a new dimension to mobilization planning: the sobering prospect of the massive destruction of our capability to produce. Until recent years we could not conceive that America's vast industrial complex might ever occupy a direct combatant status—might ever be vulnerable to attack. But today it is a stark, inescapable fact of life. Today the defense of American industry involves far more than the production of the hard goods of war.

It involves both a job for Government and a job for management. The Government must be responsible for those things which because of their very nature must be undertaken by the Government. It must see that procedures are developed for the efficient and prompt distribution of scarce and critical materials; that certain materials are adequately stockpiled; that reliable supply-requirements estimates are in being; that a sufficiently broad mobilization base is established and maintained; and it must be generally prepared to deal with the many wholly new and staggering problems which would beset the Nation in event of attack.

Further, there is an enormous job for management—a job far greater and infinitely more difficult than any which industry has ever had to face in any previous conflict. It is a job which can only be done by the owners and managers of the Nation's

important production resource, if it is to be done at all. It is a job which will not wait until the "string is out."

If an aggressor should ever decide to launch an attack upon the continental United States, it is unthinkable that there would be a "phony war" period, such as there was in World War II, during which to mobilize. It is also unthinkable that we would not have to concede the first blow to the aggressor.

Guidance and Leadership

We must not, therefore, look to the Government as the exclusive executor of the Nation's plans for mobilization readiness. The head of every industrial enterprise important to the national defense has an inescapable responsibility for doing those things which are the sole responsibility of management.

The Director of Defense Mobilization has delegated to the Secretary of Commerce responsibility for providing: "Guidance and leadership to industry in the development of plans and programs to insure continuity of essential production in the event of attack. . . ."

No Absolute Defense

That is a king-size responsibility. Some say it is an impossible job. One can only guess what the consequences of a nuclear attack upon the United States would be like. Moreover, we are aware of the practical obstacles involved in many of the steps which might be taken, such as an optimum program of industrial dispersion and protective construction. We are told that there can be no absolute defense against mass delivery of nuclear weapons and that we must assume large scale damage to the Nation's production facilities. Further, that we must assume a period of post attack paralysis of indeterminable duration and untold severity.

What, then, can be done to "assure the continuity of essential production–" One view, the utterly fatalistic view, holds that the destruction would be so complete as to render any steps useless and futile.

Another view holds that certain things could be done which might assure at least some degree of continuity; that somewhere between the extremes of achieving the impossible or doing nothing lies a feasible middle course. It is based on the premise that the managers of every business enterprise have an obligation to their stockholders, their employees, their customers, and the Nation to take such steps as will facilitate—if not assure—the continuity of their operations. The continuity of management and technical know-how is an indispensable prerequisite to the continuity of production.

In preparing the asset side of the Balance Sheet of America we are prone to list only physical plant, production, and research facilities. That is understandable. Yet, we are apt to overlook that "intangible" asset: the managerial genius and technical know-how which has made our production possible. This is something which must be preserved at all costs. Whatever may happen to the Nation's physical facilities, there must be preserved a legacy of managerial and technical know-how.

The Job for Management

Now just what is the job for Management? It is not easily defined, for it differs from company to company and industry to industry. Each company must decide for itself what is feasible and what is within the limits of its own capabilities. What makes sense for one company may be unsuited to another. Every company, however, should prepare an overall company plan for industrial defense which encompasses the activities and responsibilities of every department from the plant level to the top management echelon. While it is not possible to list all the steps which might be taken, the following occupy a high priority status: (1) Remote storage of all vital corporate records in nontarget locations; (2) Preparation of management succession plans; (3) Designation of an alternate company headquarters or rendezvous point; (4) Designation of a top company official to coordinate all industrial defense planning at the highest company level; (5) Amendment of corporate by-laws, where necessary, to facilitate emergency action; (6) Protection of all vital production, research and operating facilities against sabotage and espionage; (7) Development of plans for the assessment of attack damage, and (8) Transfer of vital production from plants in target locations to plants in nontarget locations.

Balance and Perspective

These are but a few of the many steps which many far-sighted companies are now taking to facilitate the continuity of their management and operations. They are steps which can only be taken in advance of an attack—steps calculated to reduce the lead time required to even commence the restoration and rehabilitation of essential production.

Now this business of industrial defense planning is not a very pleasant business. Those of us who are working with it every day must constantly strive to maintain a sense of balance and perspective. We, of course, share the hopes of the Free World that somehow the road will be found to a lasting peace. Further, we try to avoid the naiveté of thinking that there is an ultimate passive defense to the fearful consequences of a nuclear attack. Yet we are convinced that industrial defense is an integral part of a national posture of readiness. It is an ingredient in the economics of the Atomic Age. We dare not ignore it. We must not fail to meet it.

The Apathy Barrier

During the past two and one-half years, BDSA has held individual conferences with the top managements of some 475 companies whose products and facilities appear on the Critical Industrial Facilities List. The electronics and communications producers stand well up on this list. Similar meetings are being scheduled with other companies appearing on that list. Every effort is being made to stimulate each important producer of defense, or defense-supporting goods coming under the cognizance of this Department to take certain minimum steps, at least, which would facilitate the continuity, resumption, or rehabilitation of production.

We have learned from these conferences that a number of companies have already made great strides in the preparation of their company plans. Unfortunately, too many have

done little or nothing. All seem to recognize the importance of the problem but the big question is how to penetrate the apathy barrier. Progress is being made, however, and we are happy to report that an increasing number of companies are "on their way." We see evidence of an accumulative interest on the part of both company managements and industry groups. The examples being set by many of the Nation's leading companies are doing much to stimulate others to follow suit.

In addition to the individual company conferences, BDSA is working closely with several trade and professional organizations. Some have designated committees to study the industry-wide implications of industrial defense, others tell us they plan to do so. It is our hope that every important trade association will (a) keep its member companies currently informed on developments in the field of industrial defense and (b) stimulate them to prepare company plans for the continuity of their operations. It is our job in BDSA to work closely with such groups in every possible way. We urgently need their assistance and hope that we might work with them.

Much has also been accomplished to date through the many industry committees which advise BDSA. These IAC's — Industry Advisory Committees—have been of great help in recommending approaches to the problem, stimulating interest, and developing sound continuity of production measures. We expect to make continued use of these advisory groups as an important facet of our Industrial Defense Program.

There are a number of industry-wide problems which are receiving the attention of BDSA such as attack damage assessment. Several of our industry divisions are currently studying this problem toward the end of developing a self-triggering procedure for the assessment of attack damage by technical industry survey teams. It is hoped that considerable progress can be made along these lines during the coming months.

In conclusion, a good start is being made. We respectfully solicit your help in encouraging industry to tackle the job.

Automatic TELETYPEWRITER SWITCHING AT FIFTH ARMY

by LT. GEN. W. H. ARNOLD
Commanding General
Headquarters, Fifth Army

IN THE FALL OF 1952, THE FIRST military automatic teletypewriter switching center was placed in operation at the Headquarters Fifth Army, Chicago, Illinois. This center, known as Teletypewriter Switching Center, AN/GGC-2 (XC-1), is the prototype and forerunner of the Teletypewriter Switching Center AN/FGC-30 now in operation in the Sixth Army Area, near Davis, California, and others currently scheduled for installation at selected headquarters.

During the summer of 1940, it became evident that existing and expanded radio channels would not handle the traffic generated by partial or full mobilization. To meet the mounting traffic volume and anticipated heavier loads, other communications equipment was investigated. At what is now Fifth Army, IBM radio-type equipment was used in the fall of 1940 as a supplement to the high-speed semi-automatic radio channels. Teletypewriter Exchange Service, and some point-to-point wire channels were used to supplement the manual CW channels.

In 1943 a semi-automatic torn tape teletypewriter relay center was installed in Chicago and was used during the remainder of the war. This equipment is still used to process much of the traffic at Fifth Army. In 1952 the semi-automatic system was supplemented by the automatic teletypewriter switching center which handles between 5,000 and 11,000 messages daily on twenty channels.

The automatic switching center is designed to relay automatically teletypewriter messages prepared in accordance with existing military procedures and formats, and to process single address, multiple address, and book messages.

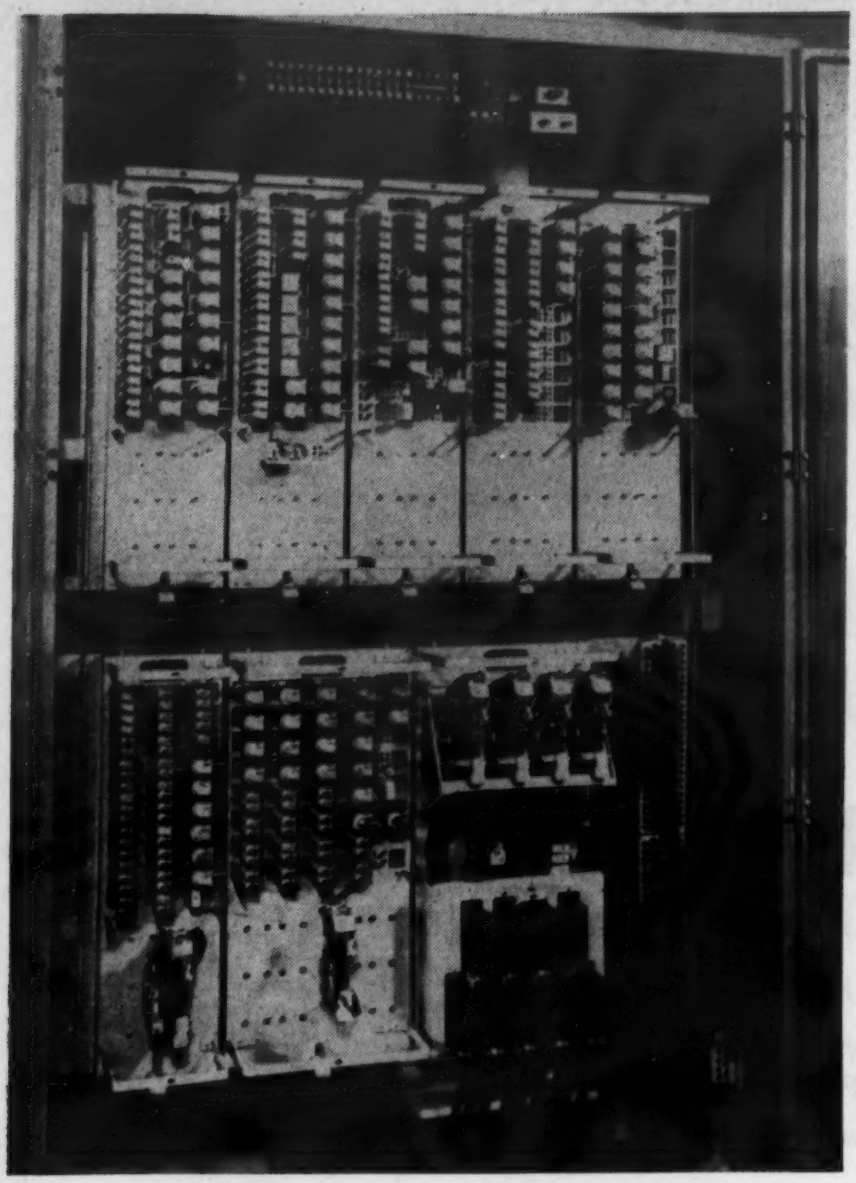
Incoming Line Units

Messages enter the switching center through teletypewriter-reperforators in the Incoming Line Units, and are reproduced on punched paper tape. This tape passes through a tape reader which transmits control information to the incoming line relays. These relays detect a new message entering the system and also check the number on this message, against a number previously set into a channel number comparator. This comparator counts the number of messages received on the circuit concerned, and stores the number of the next message to be received. If the number appearing on the message agrees with the number stored in the comparator, processing of the message continues. Should the number disagree, audible and visual alarms notify operators of the discrepancy.

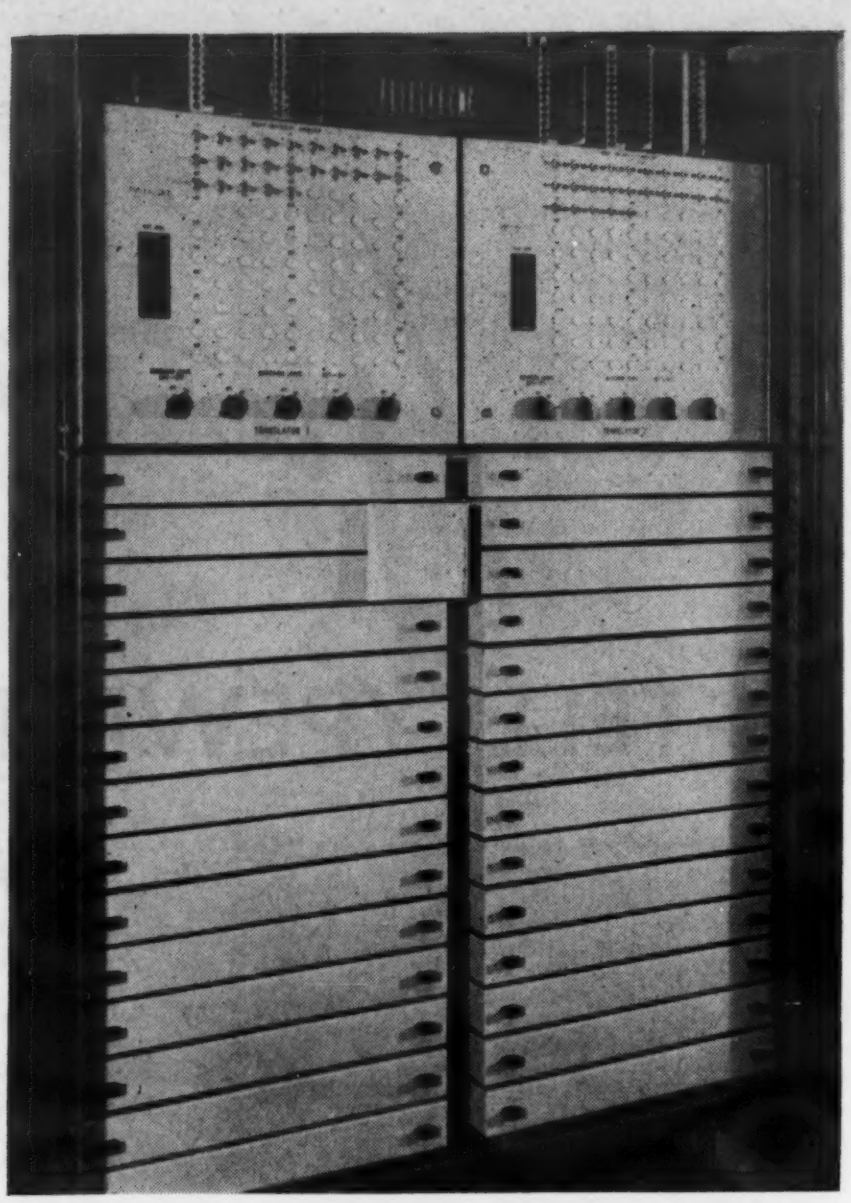
After the message number has been checked, the tape reader leads are switched to the Director. Information representing the precedence and addressee of the message is transmitted electrically to storage and control relays in the Director. The addressee information is then spilled from the Director into the Translator, and converted to information representing the circuit over which the addressee is served. This information is returned to control relays within the Director. Acting on this information, the Director activates switches in the Cross Office Selector Unit, and in the Outgoing Line Selector Units.

THE AUTHOR

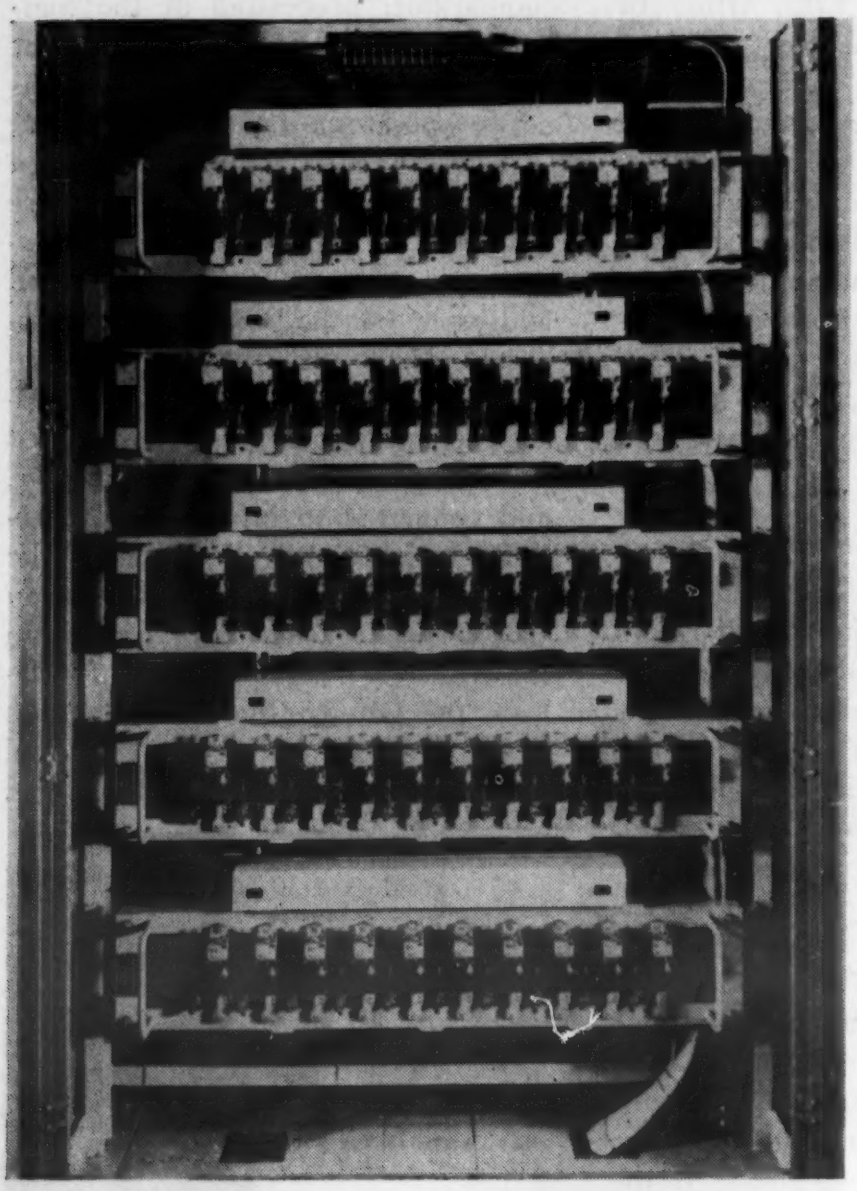
Lieutenant General William Howard Arnold, USA, is Commanding General of the Fifth Army, Chicago, Illinois. He was appointed to this post in 1955.



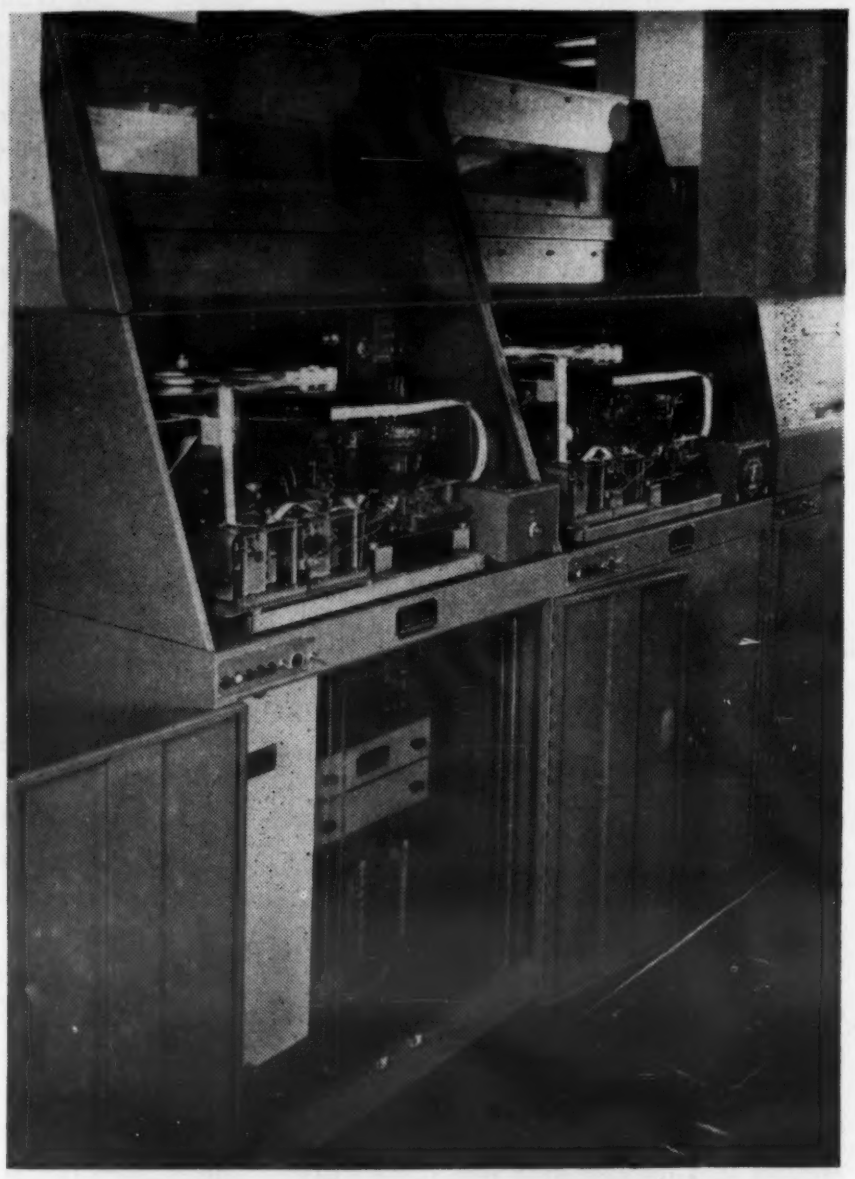
Director completes process of message in 8 seconds



Translator, front view, converts message to proper circuit



Cross office selector switches incoming message to outgoing line



Cross office storage units hold message for a clear line

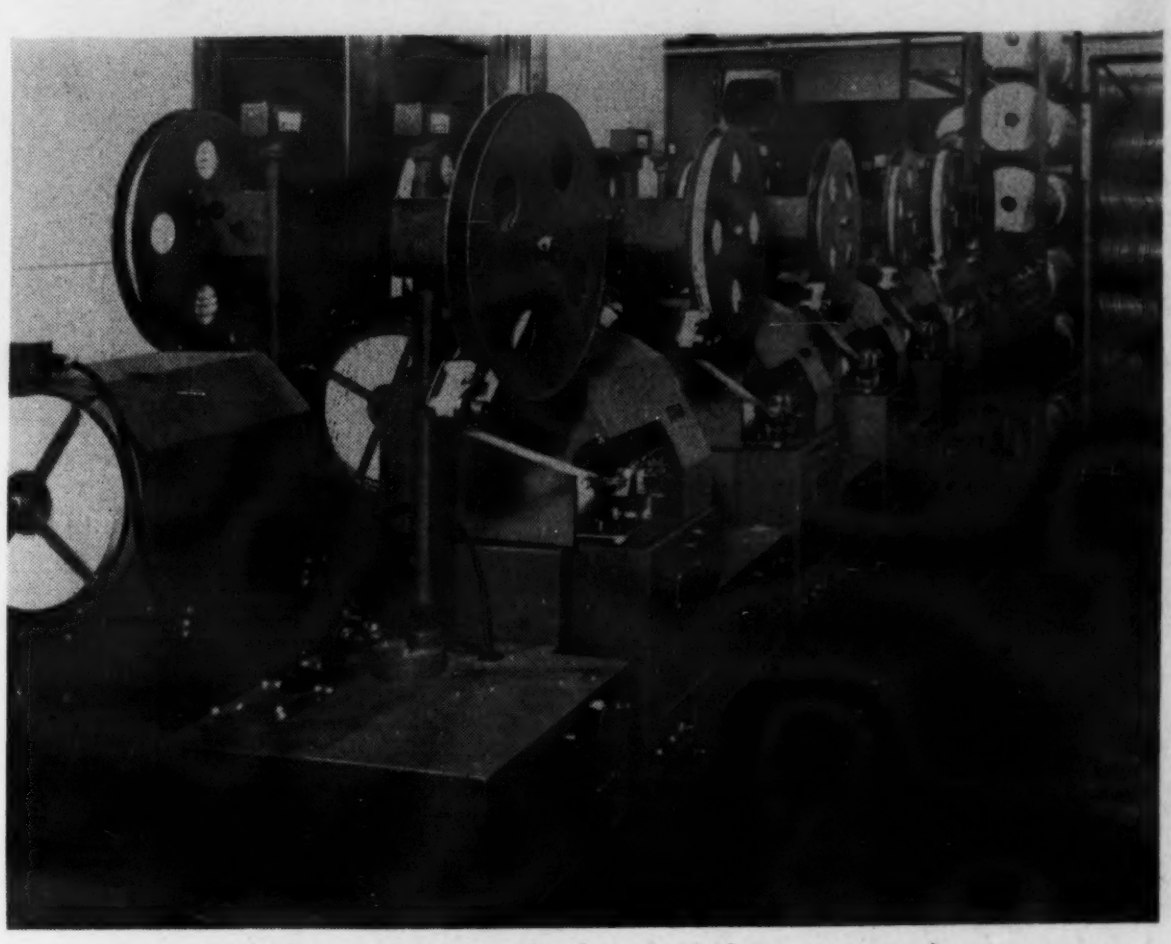
Switches within these units complete the connections from an Incoming Line Unit to a Cross Office Storage Unit, and from the Cross Office Unit to the outgoing line, through Monitor Reel Record Units.

Transmission of the message is from a transmitter-distributor in the Incoming Line Unit to a teletypewriter-reperforator in the Cross Office Storage Unit, where it is reproduced. The tape then passes through a tape reader in the Cross Office Storage Unit which, together with control relays, detects that a message is ready for transmission, and tests availability of the outgoing line. If the line is free, the message is transmitted to the outgoing circuit and is reproduced on the monitor for storage purposes. If the line is busy, the message is stored on punched tape in the Cross Office Unit until the line is available.

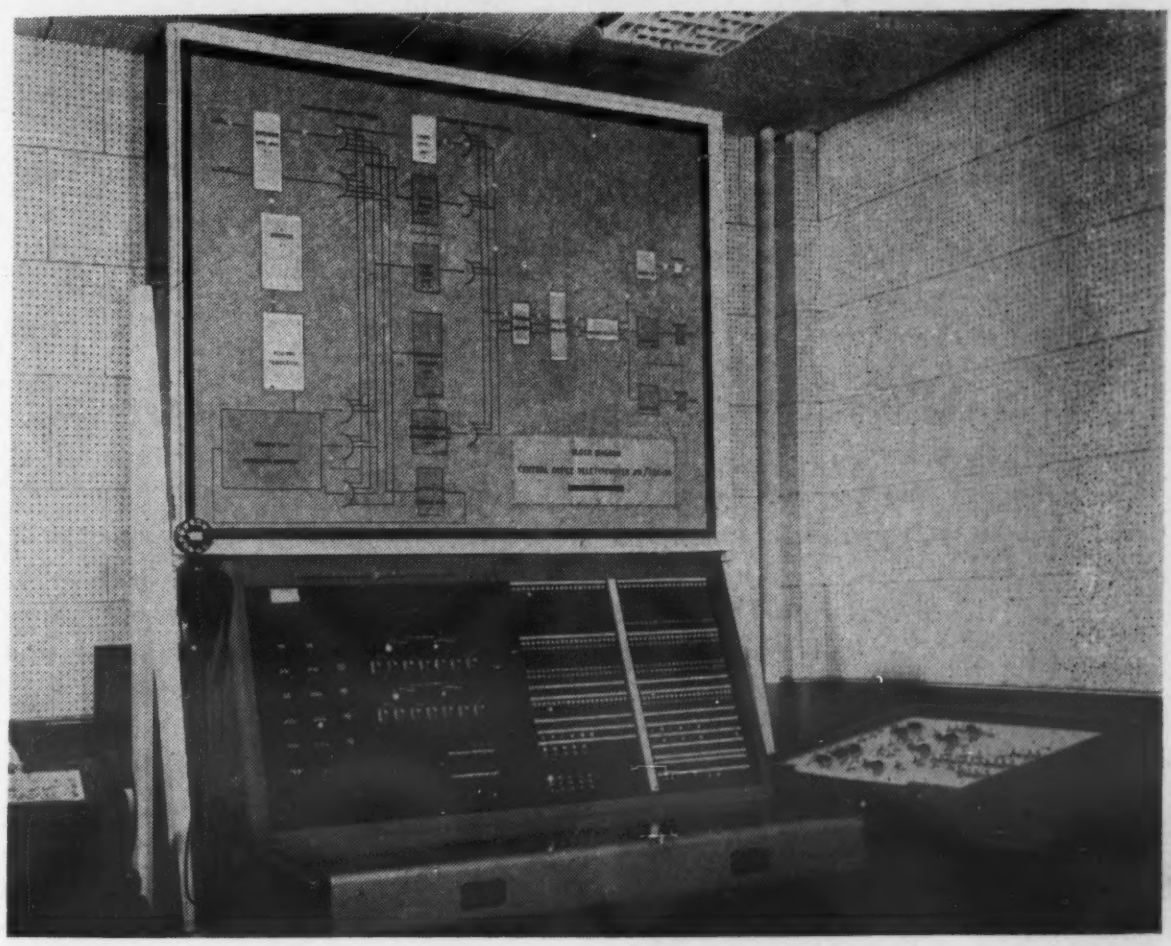
Messages are segregated and stored in precedence and address categories. During heavy traffic periods, messages for the same addressee and of the same precedence are usually stored in the same Cross Office Unit to await availability of the line. Should this particular unit be busy receiving a message at the same time another message of the same precedence for the same address is incoming, a second storage unit is used for storage of the new message. Messages are transmitted from storage in a sequence determined by precedence.

The procedure governing some types of messages requires immediate transmission and interruption of any transmission on the same line involving a message of lower precedence. This is accomplished automatically. The high precedence message enters the system in the same manner as lower precedence messages. However, when the Director receives information on the high precedence message, a new cross office connection path is established and the message is transmitted from the incoming line to an empty storage unit. As soon as information is detected in the new storage unit that the message is ready for transmission, any existing transmission of a lower precedence on the circuit involved is interrupted, the interrupted message is cancelled automatically, and the high precedence message is transmitted without delay. The interrupted message is retransmitted later as a new message. The above procedural requirement is a primary reason for common, pooled, storage equipment, others being economy of equipment and flexibility. Processing by the Director and Translator is normally completed in about 8 seconds per message. If the outgoing line is not busy or if a high precedence message is processed, the beginning of a message may be received at the receiving station before the message ending is transmitted from the originating station.

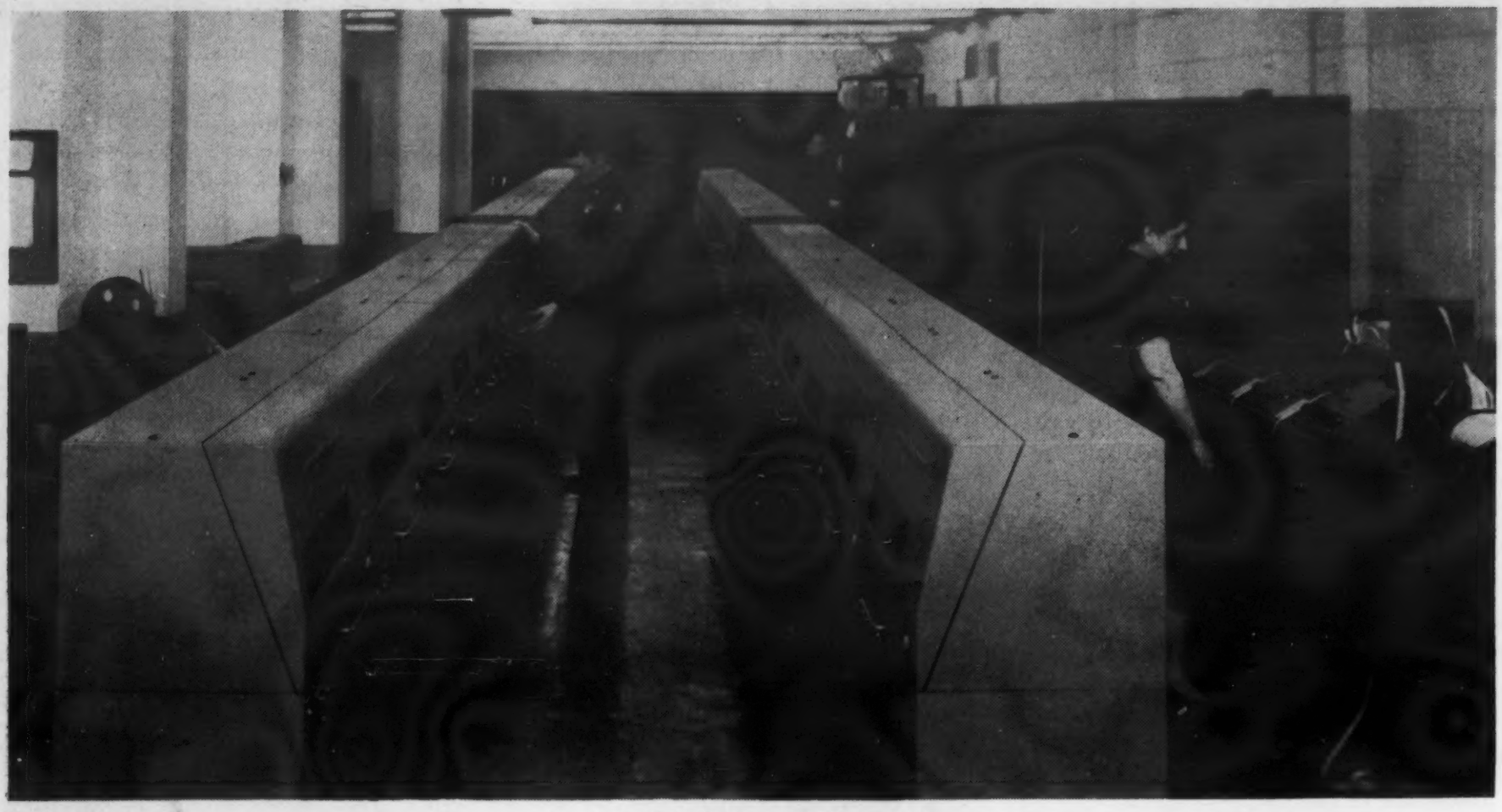
Book and multiple address messages are processed completely automatically. Incoming book and multiple address messages are received as a single tape and reproduced into as many individual messages as may be required. In this system, the maximum number of separate tapes reproduced would be twenty; these twenty tapes may carry a total of ninety-nine addressees. The capacity for reproduction, then, is governed by the number of outgoing lines available,



Monitor reel storage units through which message travels



Supervisors' console, with emergency power, controls operations



Overall view of the Switching Center

or by restrictions intentionally built into the system. On an average, four tapes are the usual reproduction requirements on book and multiple address messages. Frequently, messages with fifty-five addresses are received for processing. Messages of this type are processed in approximately eight minutes; manual processing of the same message requires sixty to ninety minutes depending on the textual length.

Intercept Positions

Facilities are provided for intercepting incorrectly prepared messages, messages containing erroneous precedence or addressee information, or messages which for any reason can not be processed automatically. The intercept positions are shown in the right center of Figure 7. Messages received at these positions are corrected by operators within the center, if possible, or the distant station is requested to retransmit a corrected copy. Messages locally corrected are forwarded to the addressee station from a position on the Manual Forwarding Unit. Each forwarding position contains control switches and buttons which permit setting the transmitter-distributor at that position to any desired outgoing circuit, and to set into the position any desired degree of precedence, irrespective of the precedence appearing on the message. This feature permits operators within the switching center to override any existing transmission, except a transmission of the highest (FLASH) precedence.

Control of operations is centered at the Supervisors' Console. On the left of the control panel, switches are provided for control of normal and emergency power. On the right of the panel appear duplications of alarms appearing on each piece of equipment within the center. From observation of the alarm lights, the condition of the entire center, or any part of it, can be determined at a glance. An intercommunications system controlled from the console, permits supervisors to direct operations within the center, as well as to communicate with maintenance and other personnel.

Speed of Operation

During four years of operation, over four million messages have been processed without a major outage of equipment or circuits. In fact, total outage to date is less than four hours. From this, it is considered that this equipment undoubtedly meets the reliability requirements for military communications. Handling a like amount of traffic on semi-automatic equipment requires 60% more personnel than is required for automatic operation. Maintenance personnel requirements increased about 15%. Initial training of operating and maintenance personnel was conducted by the manufacturer of the switching equipment; no training was required for maintenance of teletypewriter equipment since it is identical to that used in present semi-automatic communications centers. Speed of relaying and processing of messages has been increased considerably. Circuit utilization is closer to maximum than possible with semi-automatic equipment, consequently, the cost per message has been reduced substantially.

The transition from semi-automatic to automatic operation was not too difficult. With the cooperation of the manufacturer, who provided Fifth Army personnel access to a laboratory model of the equipment, training courses and instructions were drafted and presented. Training with the equipment itself was conducted during testing and debugging. Since this equipment is compatible with equipment used in other army teletypewriter stations, no major network changes were required. Minor modifications in procedures, affecting the starting and ending of messages, were made without difficulty.

The automatic switching center at Headquarters Fifth Army is firmly established as an integral part of the world wide Army Command and Administrative Network.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Laying and picking up cable on steep, uneven ground is one job for which the versatile Skagit Trac-Karrier was designed. Independent track action is shown in this view of the machine going down grade with the load pulled back over the tracks. The load is horizontal although the track at the left is lower and on much steeper pitch than that at the right. The oscillating, self-leveling tracks and walking beam construction of the undercarriage make this possible. Note the cable reel gearing at the right.

the Skagit Trac-Karrier

by Lt. Col. M. Preston Goodfellow (Ret.), President Overseas Reconstruction, Inc.

A PROBLEM WHICH FREQUENTLY plagues many people in the field of communications is the handling and stringing of cable on rough, steep terrain, swampy ground, and through water. The Army Transportation Corps also faced such a difficulty in its study of aerial tramways for handling materiel, particularly on beachheads.

How the Transportation Corps found an answer to this problem as part of the over-all aerial tramway project is an interesting story of product development.

The handling of cable would be simplified, it generally was agreed, by using a track-mounted, self-propelled reel carrier that could reel and unreel cable while stationary or moving in either direction. The unit would have to be capable of negotiating steep ground, under load or traveling light; also it must operate on rough, uneven terrain without danger of tipping, traverse soft, swampy ground and go through breast-deep water. The unit ought to be designed for multiple use in handling materiel as well as for cable reel work so it would have to be equipped with quickly interchangeable lift fork and cable reeling attachments. Since use on beachheads was likely, the forks should pick objects out of the sand. Of course, it must be compact in size and easy to move and operate.

Everyone was certain such a cable carrier would simplify the problem. The only difficulty was that no such machine existed.

Skagit Steel & Iron Works of Sedro-Woolley, Washington, undertook to engineer and build such a combination cable reeling device and lift tractor as part of its development contract for the aerial tramway project. Thus was born the Skagit PT-4 Trac-Karrier . . . a heavy duty, rough terrain, cable reeling, lift tractor.

Trac-Karrier on Operation

Many of the engineering principles which went into the machine already had been proven by Skagit Steel in its normal production of heavy duty equipment; the main achievement was combining them into one compact unit of almost unlimited versatility without complicated assemblies and controls.

Basically, the Trac-Karrier consists of four main assemblies: The undercarriage; the lift carriage; interchangeable cable reeling device and lift forks; the power unit, drive and powerful, large-capacity winch drum.

The undercarriage, mounted on "Caterpillar" tracks, embodies exclusive Skagit design features. It has walking beam construction and oscillating tracks which permit the tracks to rise, fall and change their pitch independently of each other. This provides a self-leveling undercarriage which compensates for different ground levels and permits either track to over-ride an obstacle while the other is in a depression.

On land tests at the Skagit proving grounds in the foot hills of the rugged Cascade Mountains of the Pacific Northwest, the Trac-Karrier carried full loads and laid cable on ground with steep pitches, rocks, mounds and hollows. It maintained its balance with loads carried high and low while the tracks were on different levels.

During one test a heavy truck, used to transport boxes of steel for the test, bogged down when it backed off a road. The Trac-Karrier picked up the truck with load and set it back on the road. To prove his confidence in the machine, the operator elevated the truck and load to the full height of the lift forks, more than 8 feet, and carried it over the rough ground in an unscheduled demonstration.

The lift carriage is designed to raise and lower a load; to thrust it far forward or bring it back over the tracks, and to tilt it forward or back to keep it in a horizontal position regardless of the pitch of the ground.

The carriage is operated hydraulically and is mounted on the undercarriage with rollers. It has a horizontal movement of 55 inches and is powered by a fluid motor and speed

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EDITOR'S NOTE: *The "Skagit Trac-Karrier" is a heavy duty load carrying tractor designed to operate in steep, uneven ground and in mud or water. Fully tested by the Army Transportation Corps, it is now in quantity production and should be useful in the field of communications.*

In going up hills, the load is thrust far forward to provide maximum traction. Lift carriage is vertical. Note fairleads for paying out cable when machine moves forward.

Trac-Karrier ran in four feet of salt water, laying and picking up cable to and from landing craft. Note the load pulled back over the tracks as it backs up ramp.

reducer drive which utilizes the main power unit. Raising and lowering is achieved with a combination roller chain and hydraulic cylinder mechanism.

The lift carriage tilting mechanism permits the load to be tilted from 15° forward to 30° back; this is accomplished with double-acting fluid cylinders.

In tests, the machine performed all functions easily on 48 per cent grades; it moved in a straight line over ground which required a tractor to follow a zig-zag course.

Because the motor and controls are mounted high, the unit was able to operate in more than 4 feet of salt water during amphibious operations. During one such deep water test, one track was allowed to drop off a ledge into soft mud; the Trac-Karrier maintained its level position. The reel of cable was raised above the water level, the winch line was anchored to shore, and the machine pulled itself out of the hole. The winch drum drive frictions are not affected by water and operate while submerged.

Also in the salt water tests, the machine laid cable to and from landing craft, being driven up the ramp onto the craft, forward and reverse, while the landing craft was both afloat and in shallow water. The ramp sometimes had an angle of 45° and the water depth against the engine was equivalent to 6 feet during some of these operations.

Pads which were easily installed on the grouser shoes were used to protect the deck of the landing craft. Since the undercarriage tracks have independent action and steering brakes, no difficulty was encountered in guiding the unit on the ramp where minimum clearance was available.

Movement of the lift carriage up and down, forward and back, and its tilting action are the same whether the cable reel or lift forks are attached.

The reel carrying mechanism is of steel construction with heat-treated, cut steel gears and is equipped so that the reel may be attached and lifted direct from the ground. It has a reversing mechanism to rotate it in either direction. The reel is driven by a roller chain from a power take-off on the idler shaft; the friction drive and brake are designed to maintain tension. Fairleads are provided to lead the cable over the top of the machine when cable is being laid with the machine moving in a forward direction.

Although primarily designed as a cable reeling device and lift tractor, the Trac-Karrier has a draw bar pull of 22,000 pounds, depending on the soil and load conditions.

The standard model has five forward speeds and two in reverse ranging up to 6½ MPH. Optional width grouser shoes are available. The height of the lift carriage movement can be modified to meet special requirements, standard being 8 feet, 6 inches. Gasoline or diesel power is optional.

Controlling Devices

The unit can be driven by an inexperienced operator after brief instruction; all controls are centrally located within easy reach. The track drive frictions are spring loaded and hydraulically actuated. Hydraulic operation also is provided for lifting and tilting the load and for the throttle. The horizontal movement of the carriage is controlled with a hydraulic motor through a worm gear speed reducer and roller chain. The turning brake on each track is equipped with a ratchet and also is used as an emergency holding brake. The engine clutch is foot-operated. A central gear shifter controls the transmission.

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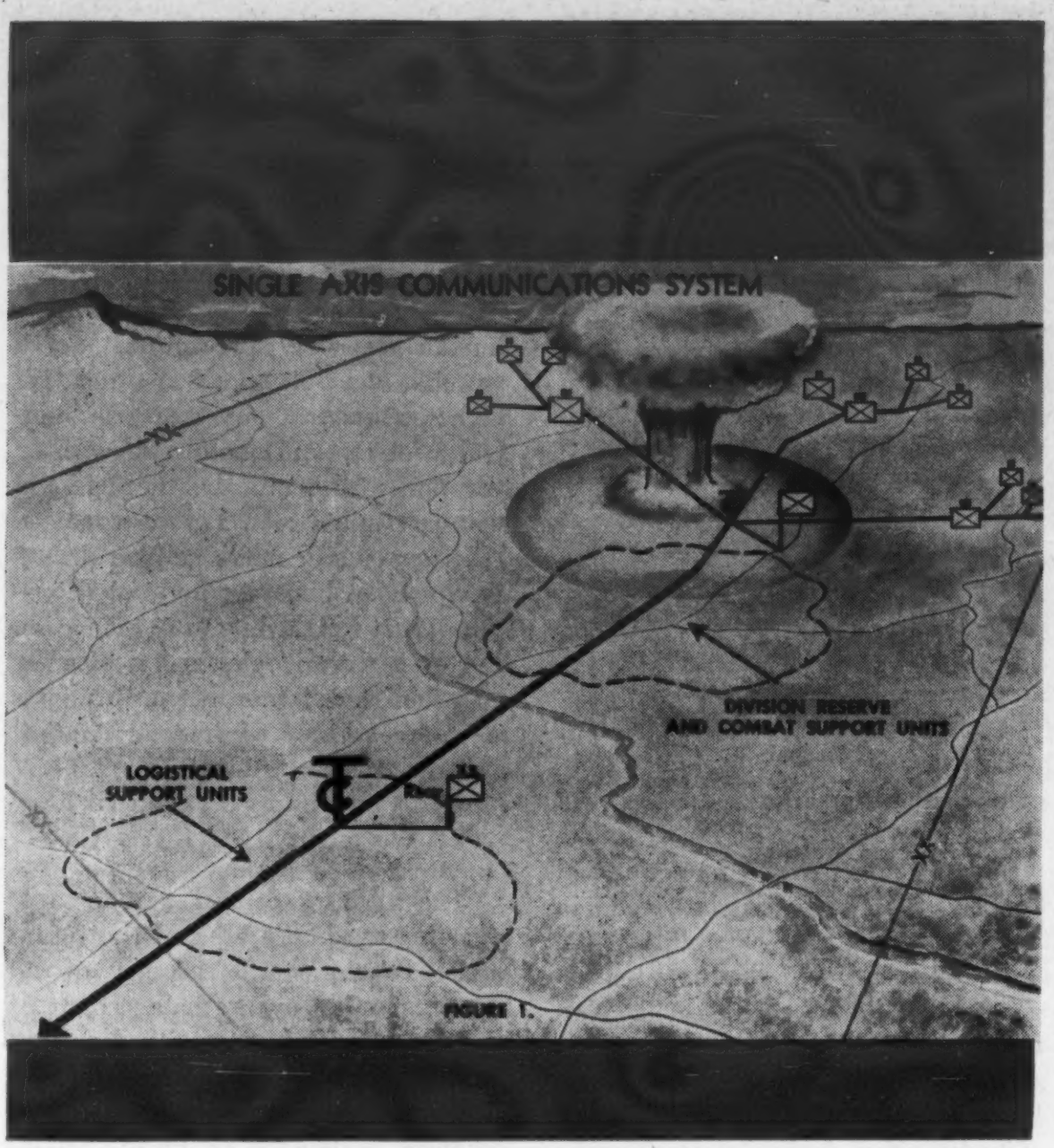


FIGURE 1.

RAPPORT

by Lt. Col. John Clapper, Jr., SC

Faculty, Command and General Staff College

THE GRAY SHADOWS OF ANCIENT history hide the secret of who first said, "To win we must fight as a team." Perhaps it was some fur-clad family that long ago foraged the forest for food, armed only with spears and clubs. Whatever its origin, the statement stands out today as an axiom, "A leader and his aids must be in rapport."

Reprinted from the November, 1956 issue of the Military Review, *published by the Command and General Staff College, Fort Leavenworth, Kansas.*

Today, if military forces are to survive and win on the atomic battlefield, the demands for close teamwork, complete integration of surveillance, reporting, analyzing, directing, and supervising functions are vital. To talk of a weapons system is to speak in terms of a coordinated and controlled organization of interdependent elements which reaches its full stature because a means exists within the structure for regulating, guiding, and managing its utilization. But let us develop the picture from a simple beginning—"In Rapport."

As combat forces grow in size, the control problem becomes more complex. It reaches its zenith in atomic operations where dispersion between units makes a meeting impossible. Thinly defended areas between units, and greater distances to travel combine to limit the visits of the commander to his units. The old system of a series of command huddles all over the battlefield has given way to more dependence upon standing operating procedures, set plays, and the application of remote control. Yet, even as these techniques are emerging, there is a greater accent on quick reaction. Speed is of the essence in atomic combat situations, whether it be on the offense or the defense.

This matter of arranging procedures for passing information up and down the line, calling for and providing mutual support, and directing the maneuver of the group applies equally in principle all the way from the simple example of a handful of men, up to and including the complex operations of powerful formations equipped with the most awesome weapons of modern war.

Command and Control

Since modern man has changed but little over the centuries, physiologically speaking, the improvement and development of the battle team has centered about new weapons, improved materiel, and better communications—more effective ways to shoot, move, and communicate.

As much as vanity may resist the admission, bravery and steadfastness are age-old virtues. Regardless of new weapons, battlefield gadgetry, and high morale, tomorrow's armies will be no bolder nor determined in the face of adversity than were the Roman Legions of old, or the valiant Allied defenders of freedom in World War II. They stood fast in the face of their fears and doubts because leadership got through to them, and welded them into highly effective battle groups. Tomorrow, then, we must have the command and control which spells the difference between a team and a mob, in a much more complex battle situation.

Once needs are known and stated, progress is under way. The fundamental sequence of filling the require-

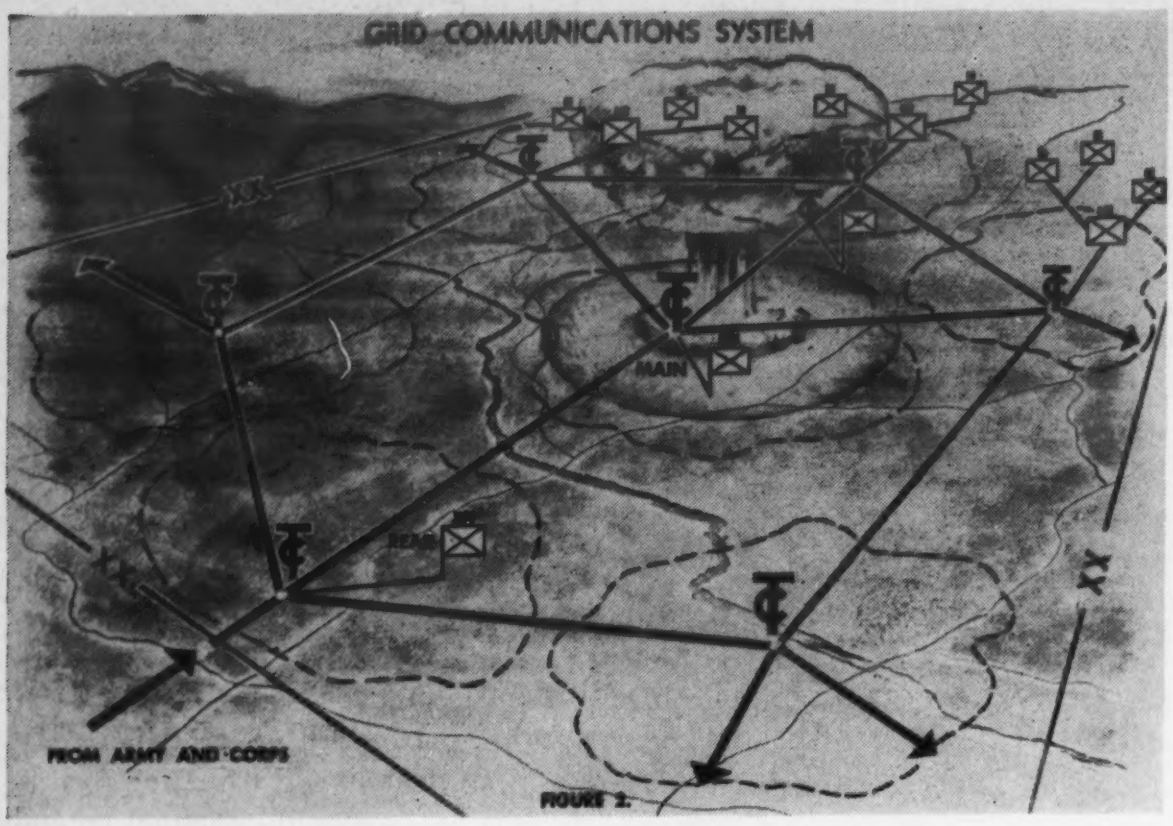


FIGURE 2.

ments should fit generally into this pattern:

1. The development of new concepts of future war in accord with national objectives.
2. The determination of the requirements in organization and equipment.
3. The determination of the weapons necessary.
4. The generation of tactics and doctrine required to exploit fully the potential capability of new weapons and materiel.
5. The evolution of the requisite means to effectively command and control the agencies involved in using the new capabilities.

Resistance to Change

Throughout the history of warfare there has been an inherent resistance to change. Despite the constant hue and cry for more means to reach the final victory with greater certainty, individual bias and inability to visualize clearly the over-all picture has led to many delays and failures to exploit new fields. Looking at the precepts of progress stated above, we can recognize that the greatest military champions were those who not only had the advantage of superior battle hardware, but also developed the technique to get the most out of what they had.

The great challenge then is to place sufficient stress and emphasis on all phases of development to acquire the maximum return from our inventory of assets. Although this article is concerned primarily with the last phase, the evolution of the requisite means to effectively command and control the agencies involved in using new military capabilities, the other elements should not be regarded as having been slighted. Naturally the last phase is dependent upon the preceding ones, and may well be developed concurrently with them.

Today, the Army boasts greater firepower and increased mobility and flexibility. Only with top quality communications can we reap their full promise. The development of new tactics, organization, and doctrine to exploit greater potentialities is being conducted zealously. Both combat and logistical operations in the fluid battles of tomorrow call for providing the control elements with a wealth of up-to-the-minute information about conditions over a large battle area. Once gathered, information must be filtered and forwarded to those who must evaluate it and revise their estimates of the situation in line with their findings. Decisions must be rapid and accurate to a degree not formerly required. And throughout the process, the system must be capable of furnishing excellent and uninterrupted communications, no matter what actions the enemy takes or what weapons he uses.

The temptation is to treat the requirements for a staff or operations control group as one entity, and to regard the requirements for a communications-electronics system which serves the control group and ties it into the subordinate action agencies as a separate and distinct package. The fault in such a view lies in a lack of appreciation for the close interrelationship between the parts. Compare the human cerebrospinal/automatic system and military response/autonomic control mechanisms. The point to be drawn is that human sensory preceptors, nerve ganglia, central conscious and peripheral unconscious response control centers, and motor impulse or reaction media are all bound into a compact unity. Psychologists advise that nerves and nerve centers directly condition behavior and consciousness. It is worthwhile to note in passing that man is physically superior to other vertebrates because he has a more highly developed central nervous system.

Nerve Center

The military central nervous system for the battle area of the future must control battle groups of all arms, moving over greater zones of influence, and must provide for rapid and adequate logistical support. Units will assemble and disperse with rapid changes in density, yet always retaining the essence of one mass. The ability, through great mobility, to concentrate and strike, and then to recoil and later exploit the devastation caused by attacks of sudden ferocity places a premium on battle area surveillance, interpretation at the operation control center, and the transmission of the reaction impulse. Human eyes and ears will be supplemented by radars, seismic and acoustic detectors, and remote airborne and ground positioned photosensitive reporting devices which are linked into integrators at response centers.

In the ultimate system, information from lower echelon data collecting and mixing centers will be reported periodically to higher echelon control centers by means of unattended electronic devices which also will respond with the latest data upon interrogation impulses from eleven echelons. The data thus transmitted will be sorted, integrated, and assessed electromechanically to the limit of human ingenuity. Prearranged response patterns, warnings, and summaries can be presented vis-

ually, stored automatically, or typed for future study by controllers. As the quantity of incoming data increases, it will be imperative that clerical operations be performed by machines.

Atomic battle concepts clearly establish the need for effective communications at all levels in the field army. Command posts, even at corps and army levels, must be highly mobile. Division CP's will move as often as once a day. Corps CP's will move as often as every two or three days, and Army CP's will displace at intervals of a week or less.

Frequent displacement makes it mandatory that all signal equipment be as mobile as the headquarters it supports. Switchboards, radio relay stations, and other facilities must be mounted in small trucks no larger than the types used by the staff sections of the headquarters. Radio communication must be continuous, even during displacement, with local direction of incoming and outgoing calls to operating staff officers by means of radio switching centers. Power units must be mounted on vehicles and fed from central fuel tanks. Antennas for even relatively elaborate radio relay stations should be so designed that they can be put up and into operation in minutes. No setting up should be required inside a truck or van. Its equipment should be ready for use instantly. Local wire lines in the CP should be fanned out as fast as men can run, with an overall result that displacement of a CP ceases to be much of a problem.

Grid System

Instead of wire lines between echelons, highly directional radio relay networks will be normal. The grid system must have the capacity and reliability to provide full switchboard-to-switchboard service on a common-user basis and also such private or sole user channels as are necessary. All transmissions must be coded automatically or scrambled with no time delay.

The destructive capability of atomic weapons and the requirement for fast, reliable, and uninterrupted communications for the control of battle groups of all arms operating over wide areas as well as for rapid, adequate logistical support, outmode the familiar single axis communications system shown in Figure 1. The blast depicted, or one severing the main axis from division main to division rear, would cause completely unacceptable disruption of the tactical, administrative, and logistical operations and control.

Figure 2 clearly shows the superior resilience and flexibility of the grid communications system. It is apparent that even complete destruction of the switching center at the hub of the system would not cause more than momentary interruption of vital communications. In fact, an enemy would find it costly and difficult, if not impossible, to disrupt communications completely—particularly if primary reliance is on radio communications. Unaffected switching centers merely would tie in with each other and nearby units and business would carry on as usual.

Radio Relay System

At lower echelons the use of tactical radio gear must be expanded. Small multichannel radio relay sets can be developed which provide eight voice and two teletype channels, identical to wire service. The artillery, infantry, and armor will all have the same basic vehicular radio set, with hundreds of channels for suitable allocation. Fully integrated battle teams thus will be possible, with no frequency problem or inability to reach to units of another arm.

Just as the combat operation of the future will be molded into an entity of weapons and control systems, so also must the administrative and logistical capability be streamlined. Without fully adequate logistical support commanders in the atomic era cannot execute their tactical plans. To keep pace, smaller and more responsive service organizations, better operating procedures, faster transportation, and improved communication techniques are necessary.

The more quickly and surely we can deliver supplies to the battle area, to the right place at the right time, the less requirement there is for combat and combat support units to carry large reserve stocks. Items used frequently in quantity will be called for and must be delivered rapidly as needed. The better the service from rear to front, the smaller the forward stocks on hand will need to be. Bulky supplies will be held in the rear until required and shipped quickly to the consumer on order. The desired effect is the development of a smaller but more responsive supply and maintenance chain to help increase tactical mobility. In the absence of superior logistical control communication facilities, the whole idea is little more than a dream.

Flow of Data

If such a system is to work effectively, "green light" supply procedures must be used. Theater policy will set forth authorizations and allocations. Control will be more centralized on critical items, less on plentiful stocks. Operations will be decentralized. Hoarding by using units will be denied by limiting transportation capability to that which will carry authorized levels only. The cumbersome multiple-item requisition of the present will be replaced in the future by single line item requisitions transmitted over wire or radio circuits from regimental and higher headquarters.

Stock and supply control will be built around electronic computers and integrators. Simple, uniform methods will be standardized, accelerating the flow of data and reducing order and delivery lead time. Aided by electronic data transmission techniques, the development of a highly responsive logistical system, long the dream of field commanders, may very well be one of the first major breakthroughs to the Army of the future.

It is imperative that machines free staff officers from the burden of manually performing every repetitive process not involving a high degree of judgment. Operation control centers must be uncluttered and quiet, yet highly responsive to the decision-making process. Delays in transmission can and will be eliminated once procedures are developed by officers specially trained to work out the complex relationships of all parts of the system. The command and control of administrative activities involves a myriad of telephone calls and message transmissions. Thus a network of high quality communication circuits will be necessary to insure continuous management over operations in rear areas. Multi-

channel facilities will be necessary to pass this heavy traffic over long distances by means of an area or "grid" system.

The form and nature of future tactical and logistical operations will be influenced greatly by increased use of Army aircraft. Army air operations will be conducted in all weather, at all hours, usually at low altitudes over electronically defined air routes. Communication and traffic control will cause the orderly movement of large numbers of planes, fully coordinated with tactical air support and anti-aircraft defense.

Unique Frequencies

The basic principles of flight control operations are not new. The United States Air Force and the Civil Aeronautics Authority are rich sources of guidance. However, certain unique requirements of the Army have no outside counterpart which can be exploited. Army airfields will be created hastily and heliports will mushroom wherever the tactical situation dictates. Communication, air navigation, en route flight assistance, and landing aids for the field army will be "here today, there tomorrow." Only by the most carefully integrated system of command, control, and communications-electronics will the Army's own control over its flight operations meet expectations.

The fundamental test of understanding comes from uncovering basic principles and applying them properly. As a truth is recognized as being generally applicable, the details behind it lose much of their mystery. The more intricate problems of military signaling are being studied and solved by forward thinking officers who plan to use communications not as technicians but as commanders.

In the final analysis the commander who figuratively sub-divides his control system into its parts to understand how and why it works is well on his way to gaining the know-how to exploit the full capabilities of his command. Perhaps this is why so much attention is placed upon the need for superior communications by top military leaders who emphasize the absolute necessity for the closest union between the commander and his control system.

PHOTOPROGRESS

by FRANK SMITH
Photo News Editor, SIGNAL

Hycon Lightweight Aerial Reconnaissance Camera

Something new in lightweight aerial reconnaissance cameras has been developed by Hycon Mfg. Co., Pasadena, Calif. Designed for use in missile and high speed drone aircraft, the camera can also be used for more conventional aerial reconnaissance tasks.

Known as the KA-20, the camera uses 9 x 9-inch film and 6-inch metrogon lens to provide a maximum area of coverage. It weighs only 17 lbs., one-fifth the weight of comparable aerial cameras. Built-in image motion compensation, which adjusts for the airplane's forward speed by moving the film at the time the exposure is made, assures sharp photography. Because of its size, light weight, and 9″ x 9″ format, the camera has application in all types of aerial platforms, both manned and unmanned, where weight is a critical problem. Missile and rocket use is completely possible with the new KA-20, since it has repeatedly withstood launching and landing loads of 40 G's according to officials of the company.

The first KA-20 was made specifically for installation in the Radioplane RP-17 drone and was developed under the direction of the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. It has been field tested by the U.S. Army Electronics Proving Ground.

Mirror Type X-Ray Camera

A new type X-ray camera which results in a 70 to 75% reduction in X-ray exposure to the patient has been announced by the General Electric Co., Milwaukee, Wisc. The camera portion of the unit is produced by the Fairchild Camera and Instrument Corp., Jamaica, N. Y. Heart of the new camera is a special mirror, which applies the same principle that is employed by astronomers to photograph light from the distant stars. The reduction in X-ray exposure is made possible by the mirror's optical speed which is between 4 and 5 times greater than that of refractive lens type cameras hitherto used. The large-diameter mirror system, similar to those used in giant telescopes, is reported to produce sharper and clearer images than have hitherto been possible. This system permits an extremely wide working aperture of f/0.7 (GRA f/0.65). Resolution of the X-ray image is 4 times that of refractive-type lens camera previously employed.

Developed by Fairchild in cooperation with the N. V. Optische Industrie, (Odelca) of the Netherlands, the new camera features the Bouwers concentric mirror optical system, which greatly surpasses the light-gathering capacity of the conventional lens.

The camera uses miniature 4″ x 4″ or 70mm film which provides considerable economy over the use of larger film sizes. The camera can be adapted to serial film work permitting the taking of from 1 to 6 frames per second.

Kalfax Photographic System

A wholly new and revolutionary photographic process called Kalfax which requires no chemicals, fumes, vapors or the like has been developed by T. J. Moran's Sons, 909 South Broad St., New Orleans 25, La.

The Kalfax Process uses physical development rather than conventional chemical development processes. The developing agent is heat applied at a moderate temperature, and is clean and simple and consists of only two steps—expose with light and develop by heat.

The sensitivity of the present Kalfax emulsion is in the ultra-violet band of the light spectrum and thus the material can be handled in daylight or ordinary room light. This characteristic of Kalfax enables operations to be carried on with greater flexibility and permits the application of principles of photography to a new and unusual series of applications.

Kalfax emulsion is essentially grainless and the resolution of the material is superior to most of the conventional silver-halide emulsions.

Image permanence is substantially greater than that of conventional photographic materials and the Kalfax film displays insignificant loss of image when subjected to temperatures as high as 200F. Humidity tests have been made by completely immersing the developed material in water for long periods with no image deterioration.

Kalfax photographic papers may be of any color, thus achieving a number of colors without charge in either exposure or development techniques. The process is ionizing radiation proof and the materials may be used in

"hot" areas without adverse effects.

The sensitized materials may be coated on anything and the copying material will reproduce continuous tone pictures usable in commercial photography for proof-reading. Various units of equipment have been developed to use Kalfax paper and film as follows:

a. Kalfax Enlarger. Projection prints from 35mm or 16mm microfilm frames up to 14 x enlargement in 30-40 seconds.

b. Kalfax Film Printer. This unit exposes and develops in one operation 35 or 16mm film in strip or roll at a speed of 5 to 24 feet per minute.

c. Kalfax Photocopy Machine. Same size contact prints up to 11 x 17 in less than one minute.

New Lamp Developments

A new photoflash lamp development which is sure to be welcomed by photographers everywhere is the Amplex baseless photoflash lamp which is a product of the Philips Laboratories, Eindhoven, Netherlands. Designated as the "My-T-Myte" PF1 (clear), the new baseless flash lamp fits any bayonet-base flashgun through the use of a simple inexpensive adapter. The baseless lamp, which is described as revolutionary by the distributor, is a medium-peaking lamp with a peak duration of 18-20 milliseconds and is suitable for use with all presently available fixed focus and synchronizing cameras.

Output of 7,500 lumens makes the baseless the most powerful, small lamp available in America. A blue baseless bulb, PF1B, is also available for the Daylight Type Color films. The adapter, which can be purchased for 20 cents, is provided with an ejector lever which can be operated with a simple flick of the finger. The Amplex Corp., 111 Water St., Brooklyn 1, N. Y., has been appointed exclusive distributors of the lamp in the United States. List price of the PF1 (clear) is 9 cents each. The PF1B (blue) is 11 cents each.

Another lamp development which is sure to interest all projectionists is the new Westinghouse 1,200 watt projection lamp which is claimed to give 30% greater screen brightness. Designated as the 1,200-watt T-12, the lamp is designed to work with existing projection equipment and is interchangeable with present 1,000-watt lamps.

Nearly two inches shorter than other 1200-watt lamps, the new light source has the same filament size as 1000-watt lamps. Engineers of Westinghouse state that the lamp has one of the most compact filaments ever made.

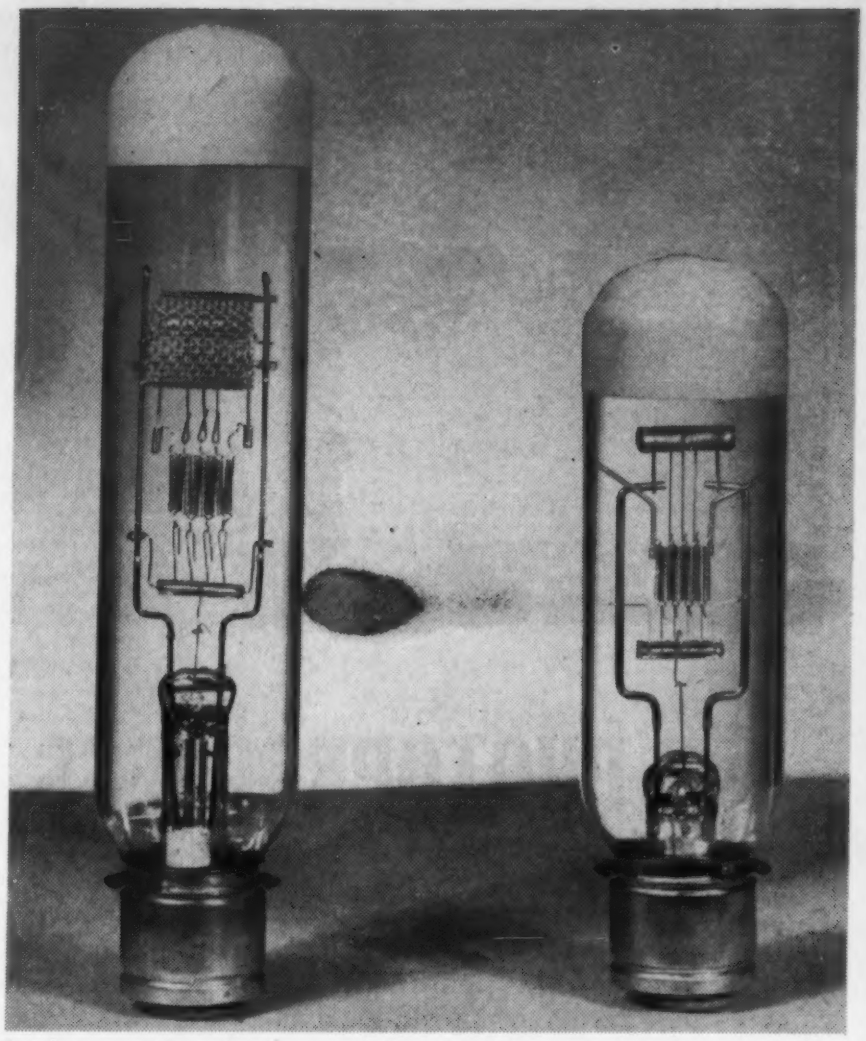
One of the important advantages of the new lamp is that it permits the use of the new wider screens. The extremely compact filament used in the new lamp was made possible by the development of new techniques of drawing tungsten wire and an exclusive floating bridge filament construction. This design allows the placing of the coils close together without danger of shorting when the filament expands upon heating.

Photographic Pamphlets

One of the most interesting and at the same time handiest of booklets to come off the presses recently is the new 1956-57 *Optical Industry Directory*, priced at $5.00 and published by the Optical Publishing Co., Box 542, Huntington, L. I., N. Y.

The directory consists of 309 pages of information designed for ready reference. This new edition gives up-to-date information on some 3,000 domestic and foreign suppliers of optical components, instruments, raw materials, and services.

As a new feature it lists the pertinent data regarding thousands of commercially available corrected lenses for



Brighter motion pictures may be obtained with existing projection equipment as a result of a new 1200-watt projection lamp developed by engineers of Westinghouse which is interchangeable with present 1000-watt lamps.

photography, instrumentation, and other special uses. Outstanding leaders in theory, development, manufacture and use of optics and optical instruments have indicated their specialities in the personnel section.

The expanded index of enumerated items (349) is a true glossary of modern optics. The directory is an indispensable tool for the purchasing agent, engineer, research worker, and manufacturer regardless of his particular field of optical specialization.

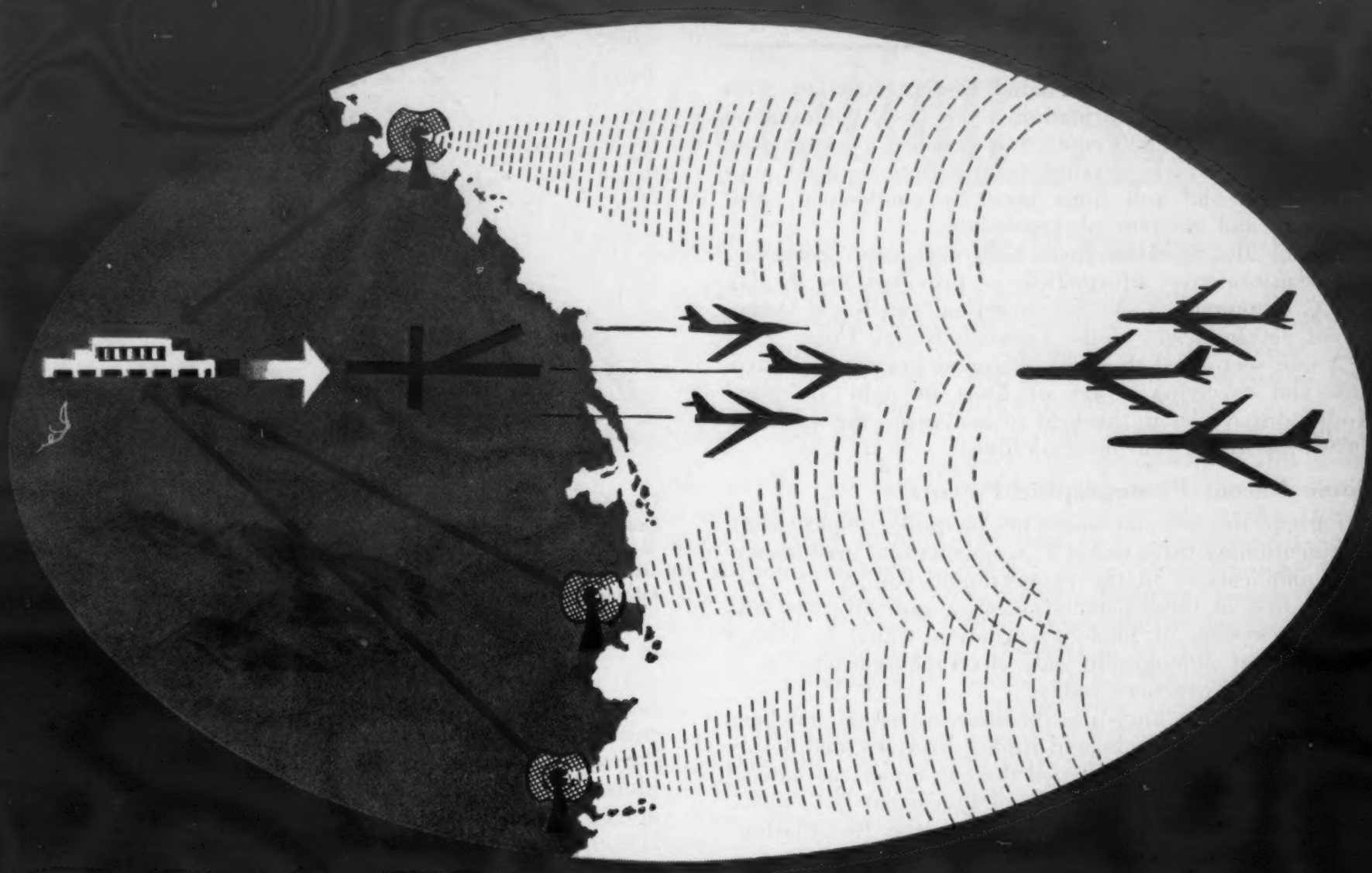
One of the neatest publications to come to the attention of your writer is the new 88 page handbook of Ansco covering color photography with the new high-speed Anscochrome color transparency and motion picture films. The new handbook is entitled *How to make better Color Pictures With High-Speed Anscochrome Film* and gives full and detailed directions to help even the least experienced photographer make superior-quality color transparencies on high-speed Anscochrome film.

Containing 53 four-color illustrations, the new book is priced at a modest 75 cents.

The booklet is comprehensive in coverage and gives considerable useful information on such subjects as correct exposure, using exposure meters and guides, diagrams and charts of indoor lighting arrangements, nature of light and how colors are formed, latest official Ansco filter recommendations, processing instructions, and a host of others. The book may be obtained in most camera stores or direct from Department of Publications, Ansco, Binghamton, N. Y.

One of the minor problems confronting the user of Kodak films has been to keep up with the many new and improved films of this brand hitting the market in recent months.

This problem has been very neatly solved with the publication of the 7th edition of the Kodak Data Book entitled *Kodak Films For Black and White Photography*.



SAGE

SEMI-AUTOMATIC GROUND ENVIRONMENT

speeds security . . . with the help of Burroughs computation

Briefly, SAGE does this: employs radar and electronic digital computers to detect and identify approaching enemy aircraft; determines appropriate defensive measures such as antiaircraft weapons, missiles, or intercepting planes; guides missiles and interceptors to the target and then returns planes to their home base.

Burroughs has the SAGE job of helping to speed the correlation and translation of warning data through automatic computation. This entails research, development, prototype design and engineering, production, installation, training and field maintenance.

Here is just one of many significant Burroughs contributions to defense in the areas of instrumentation, control systems, communications, electronic computers, data processing. And on the basis of our proved skills, facilities and experience, we welcome further inquiries regarding defense contracts. Call, write or wire Burroughs Corporation, Detroit 32, Mich.

INTEGRATED BURROUGHS CORPORATION DEFENSE FACILITIES INCLUDE:

Burroughs Corporation plants in Detroit and Plymouth, Michigan
Burroughs Research Center, Paoli, Pennsylvania
ElectroData Division, Pasadena, California
Control Instrument Company, Brooklyn, N. Y.
Electronic Instruments Division, Philadelphia, Pennsylvania
Electronic Tube Division, Plainfield, N. J.
The Todd Company, Inc., Rochester, N. Y.

Burroughs

The Foremost Name in Computation

Looking to future expansion, Burroughs invites inquiries from qualified engineers.

All the new films are included therein together with complete technical information. The book contains 68 pages, is priced at 50 cents and explains photographic processes, and gives detailed information on black-and-white sheet and roll films used by commercial, professional, and amateur photographers.

Among the 15 films for which exposure, processing and sensitometric information is provided are Kodak Tri-X, Panatomic X, Verichrome Pan, and Royal Ortho, recent developments of the Eastman Kodak Co.

A new section of the book discusses graininess, sharpness and revolving power of films in light of recent Kodak discoveries in the field of acutance—the scientific measurements of sharpness of films.

Some Recent Photographic Patents

Perhaps this account would not be quite complete without mentioning three recent U.S. patents that may possess wide implications in the photographic field.

The first of these patents covers a radically new and different system of photo recordation which is neither conventional photography nor electrophotography as it is known and practiced today.

Such a process, known as the electrodynamic, has been invented by J. E. Jacobs and Rudolf Frerichs, and a U.S. Patent #2,764,693 was issued thereon under the date of September 25, 1956. The title of the patent is "Process and Apparatus for Image Production and Recordation" and briefly, the principle of operation is as follows:

The method, which uses a photosensitive screen of finely divided semi-conducting crystals of current amplifying material, produces images in terms of electrical currents, flowing in each and every portion of an image producing area, whereby the image may be recorded by applying the currents directly to a current sensitive sheet to mark the same, thereby reducing the recording procedure to one of utmost speed, precision, and simplicity by avoiding the chemical procedures inherent in conventional silver-halide photography and the mechanical dust pattern transfer procedure of xerography.

The photosensitive layer may consist of cadmium or mercury sulphide or cadmium selenide, or other semiconducting material having the inherent capacity of operating as an electrical current amplifier when irradiated with light rays from the ultraviolet to X-rays.

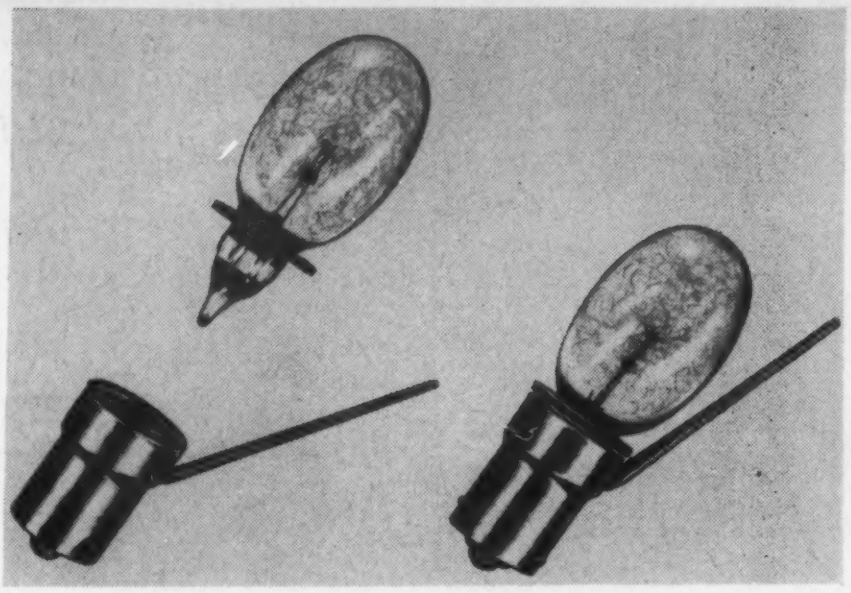
The patent comprises 13 claims and has been assigned to the General Electric Company.

Improvements in Electroluminescent Lamps

Another patent U.S. #2,755,400 issued July 17, 1956 to C. B. Stiles and assigned to Sylvania Electric Products, Inc., Salem, Mass. mainly covers improvements in the basic electroluminescent lamp.

The inventor states that he has found that the light output greatly increases as the temperature is raised above 100 F. In some cases, the output is increased six times or more above that obtainable at room temperature. The reason for this increase is that formerly the voltages used were not sufficient to raise the temperature of the lamp more than a few degrees above ambient. Several means may be used to increase the temperature of the lamp, among them being, heating the lamp by external means, such as by a separate heater resistance, increasing the resistance of the lamp electrodes by increasing the resistance of the transparent conductive layer, increasing the voltage across the lamp and increasing the frequency of the voltage.

However, the inventor states that it generally will be found to be more efficient to let the lamp heat itself by raising the voltage or frequency or both and by enclosing the unit in an inverted outer glass envelope.. As an illustration, a graph appended to the patent shows that at 150 F. and 250 volts, the brightness in foot lamberts is approximately 0.8. At 150 F. and 550 volts the brightness is approximately 2.8. As the brightness values of the electroluminescent lamp are pushed higher and higher, the lamp becomes increasingly more valuable as a possible photographic illumination source since this factor, more than any other, has prohibited its use.



The Amplex Baseless PFI Photoflash Bulb slips into its permanent adapter base which fits any bayonet-base flashgun. Lever at right of adapter ejects the used bulb. American Flashgun manufacturers are now working on designs that will take the Baseless Bulb directly without an adapter, and a number of European guns for the Baseless Bulb are now on sale in America.

Electronic Exposure Control Device for Variable Contrast Photo Papers

U.S. Patent #2,764,060 issued to Robert J. Roark, September 25, 1956, assigned to E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware, covers an electronic exposure control device for variable contrast photographic papers. As is generally known, one of the problems encountered in printing variable contrast photographic papers is the subjective opinion of the operator required in selecting the proper filter, paper, and the exposure required.

According to the inventor, the subject electronic device eliminates the above making all operations in effect automatic, or semi-automatic, and requiring a minimum of human intervention. The device essentially comprises an electro-optical scanning system having a photoelectric detector which generates a pulsating E.M.F. in response to the light transmitted by the negative when a representative area of the negative is scanned by a Nipkow disk or like device. This E.M.F. is transmitted to two parallel connected electronic circuits, one of which indicates (or controls) the duration of the total light exposure as a function of the density of the negative, while the other indicates (or controls) the light quality as a function of the contrast of the negative.

The inventor claims that the device is compact in arrangement, and can be adapted for attachment to a wide variety of designs of conventional photographic printing equipment. Furthermore, the apparatus is claimed to be low in first cost and maintenance, and the automatic or semi-automatic feature provides for an increased production rate.

Association Affairs

1957 Convention News

The National Convention Chairman, Admiral Joseph R. Redman, has made the following announcement regarding Committee Chairmen for the AFCEA Convention to be held at the Park-Sheraton Hotel May 20, 21, and 22, 1957.

Chairman in charge of organizing the program and securing the technical papers is Francis H. Engel, RCA. Entertainment and banquet arrangements will be made under the leadership of John L. Gilbarte, Admiral Corp. Mrs. Engels will organize the committee handling the program of ladies activities.

The Tours and Transportation Committee will be headed by George Sheets, Stromberg-Carlson, and Roland C. Davies, *Telecommunications Reports*, will direct the public relations.

William C. Copp, of William C. Copp & Associates, will handle the exhibits again this year. Frank Martins will be treasurer and Burnett R. Olmsted will take care of the administration and budget.

Exhibits

In the short space of three weeks a total of 90 exhibit spaces out of the 160 available have been contracted. Since spaces are going rapidly, organizations which anticipate securing space should not delay in mailing their request.

Technical Papers

The response to the request for technical papers to be presented during the convention has been most gratifying. A total of 45 papers on various subjects have been received to date. From this number, the Chairman for Technical Papers and his Committee will choose a total of 12 for presentation.

Attendance

From all indications, this year's convention will be the biggest in the history of our Association. Approximately 3500 representatives from the military and from business are expected. This will exceed the attendance at our Boston Convention by 2000. Special plans are being made for the ladies to tour points of interest in the Washington area.

General Blake Moves to New Post

Maj. Gen. Gordon A. Blake took over a new assignment on January 1 as Commander of the United States Air Force Security Service at Kelly Air Force Base, Texas.

General Blake takes a wealth of electronics experience to this assignment having served as Director of Communications-Electronics, USAF, for over two years, from January, 1953 to June, 1956. In June, 1956, he became Assistant Deputy Chief of Staff, Operations of the Air Force.

A leader in AFCEA, General Blake served as the National Director of chapters from June, 1954 to June, 1955. From 1953 to 1956, he was a national vice-president and served as a member of the National Board of Directors and of the Executive Committee.

Overseas Interest in SIGNAL

During the past two months, it was gratifying to note that our overseas chapters have evinced an interest in the change of format and the type of material contained in SIGNAL. This is a forward step and one which pleases the National Headquarters no end. In this connection, SIGNAL would be pleased, not only to receive worthy comments, but also to receive interesting articles for publication in the field of communications, electronics and photography by members of our overseas chapters from time to time.

Past Issues of SIGNAL

National Headquarters has received quite a few requests for past issues of SIGNAL which we advertised for sale at $1 per copy in a previous issue of SIGNAL. Since we will dispose of our supply of past issues on March 1, we would like to suggest that those chapters or individual members, who have not yet placed orders for copies desired, do so before the deadline date. National Headquarters will be glad to make available without cost copies of our last 4 issues for use at banquets or Association meetings to pass out to visiting guests. If any chapters desire to take advantage of this opportunity, please communicate with the Washington office before March 1, 1957.

AFCEA Group Members

Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corp.
Air Associates, Inc.
Aircraft Radio Corp.
Alden Electronic & Impulse Recording Equipment Co.
Allied Control Co., Inc.
Allied Radio Corp.
Almo Radio Co.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Argus Cameras, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Berkshire Transformer Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Clevite Transistor Products, Division of Clevite Corp.
Coastal Publications Corp.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Contraves Italiana
Compagnie Francaise Thomson-Houston
Convair, Division of General Dynamics Corp.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
Dukane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
Federal Telecommunication Laboratories
Federal Telephone & Radio Co.
General Aniline & Film Corp.
General Cable Corp.
General Communications Co.
General Electric Co.
General Telephone Corp.
Gilfillan Bros., Co.
Globe Wireless, Ltd.
Gray Manufacturing Co.
Haller, Raymond and Brown, Inc.
Hallicrafters Co.
Haloid Co.
Hammarlund Manufacturing Co., The
Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hercules Motor Corp.
Hitemp Wires, Inc.
Hoffman Laboratories, Inc.
Hogan Laboratories, Inc.
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ACTIVE STUDENT CHAPTERS

Iowa State College, Ames, Iowa
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Chapter News

Baltimore

The chapter's October meeting, held at the Bendix Radio Division, was highlighted by a tour through the corporation's new engineering building. A buffet dinner preceded the tour.

E. K. Foster, manager of the plant, acted as host to the group of 160 members and guests, and introduced the guides who took groups of members through the new building.

The 100,000 square-foot structure, which includes spacious work areas and offices, has an auditorium, a complete printing plant, engineering library, and loading dock.

The Air Research and Development Command entertained the chapter at a dinner-meeting November 13. A film, "The Time of War," was shown.

The theme of the film was the need for scientific and technical progress in aviation. It explained that "The War of War" requires that we get ahead and keep ahead as far as possible and that research and development are playing an important part in this fight. The film also pointed out the ideas, missions, and organization of ARDC and how it works along with industry.

The host of the evening was Col. C. R. Tosti, Assistant Executive Officer to Lt. Gen. Thomas S. Power, ARDC.

Boston

The chapter's November meeting was held at the Western Union plant where members and guests were taken on a tour by Robert Dirkes, assistant vice president of the company.

Mr. Dirkes explained his company's latest facsimile equipment to the group and later discussed switching center devices developed by Western Union for its customers.

Chicago

The chapter's tenth anniversary was celebrated at an October dinner-meeting in the new Headquarters of the Chicago Air Procurement District, USAF. Col. LeRoy C. Lewis, Chief of Chicago Air Procurement District and a member of the chapter's Board of Directors, was host.

The program, divided into two parts, was opened by Maj. Gen. W. O. Senter's speech, "Facing the Engineer Personnel Shortage." General Senter is the Commander of the Oklahoma City Air Materiel Area.

The remainder of the program was devoted to the outlining of Col. Lewis' Command, including the explanation of contract administration and procurement assistance to potential suppliers. To aid the members' knowledge of the subject, a detailed index of Commodities and Air Materiel Command Purchasing Offices was distributed.

Brig. Gen. William D. Hamlin, Commanding General, TASSA and Brig. Gen. Hiram D. Ives, Illinois Military District were the distinguished speakers at the chapter's November meeting.

General Hamlin spoke on "Procurement Trends and Comparison of the Chicago Regional Office to Overall Signal Corps Procurement."

The topic of General Ives' speech was the "Reserve Officers Act of 1955 and Its Effect on Industry."

The dinner meeting was held at the 5th Army Headquarters and the host was Col. Marlin S. Moody of the Signal Corps.

Kansas City

John Knoell, operations supervisor, Airways Operations Div., Civil Aeronautics Authority, Kansas City, was the guest speaker at the chapter's October meeting.

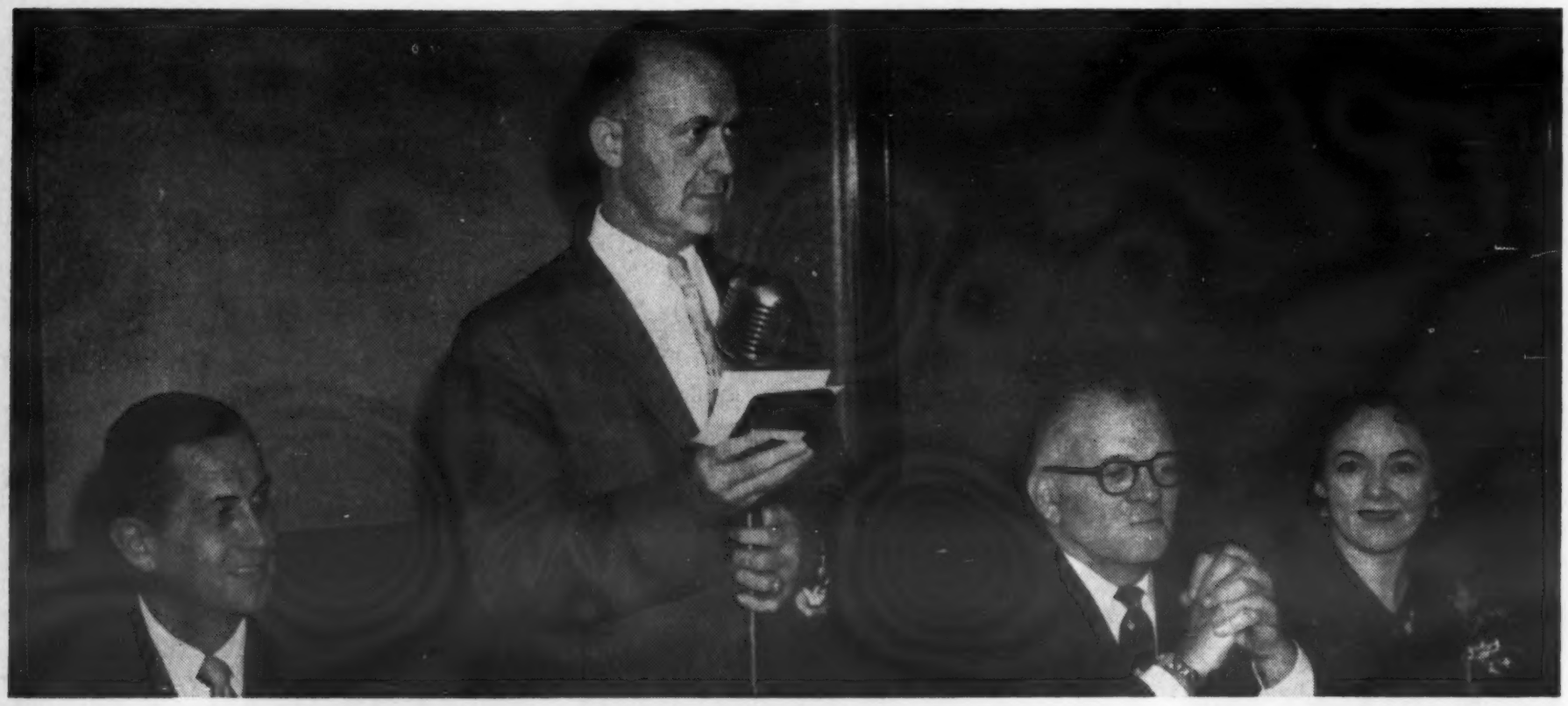
Speaking on the activities and plans of the Civil Aeronautics Administration, Mr. Knoell thoroughly discussed air traffic control in the past, present, and future. Upon the conclusion of his talk, he conducted a general question and answer period.

Korea

Approximately 100 Signal Corps officers from all over Korea recently gathered together at the Chosen Hotel, Seoul, Korea to attend the last meeting held under the leadership of Col. William Gaeckle, chapter president.

Coincident with this meeting was the periodic visit of Gen. Harold Hayes, Signal Officer, Army Forces, Far East, who attended the dinner and spoke briefly to the group.

Colonel Gaeckle, who left Korea on December 1, relinquished his gavel and chairmanship to Col. Walter E. Lotz, Signal Officer, 8th Army. Colonel Lotz will act as chapter president pending submission of a new slate of officers for 1957 by the nominating committee.



Shown at the Baltimore Chapter meeting held at the Bendix Radio Division, Bendix Aviation Corp., are, left to right, William E. Cleaves, Bendix Radio General Sales Manager; Chapter President George C. Ruehl; E. K. Foster, Vice President and General Manager, Bendix Radio; and Mrs. Foster. The program included a tour of the new Engineering Building of Bendix.

Robert Dirkes, Western Union assistant vice-president, explains his company's latest facsimile equipment to Col. Murray D. Harris, Northeastern University PMS&T, at a recent meeting of the Boston Chapter. Looking on are, left to right Maj. Wilbur DePauw, Boston Army Base; Elmer Cutts, WU area superintendent; V. L. Hughes, WU Eastern Division manager, private wire sales; David R. Hull, Raytheon vice-president; Chapter President Fred E. Moran; and George G. Creal, WU general manager.

The gathering was honored by the presence of Brig. Gen. Briand I. Johnson, Commanding General, Eighth Army Support Command; Brig. Gen. Charles R. Bixel, Acting Chief of Staff AFFE/8A (Korea); Dr. E. T. Cho, retired Chief Signal Officer, Republic of Korea Army; Col. Robert W. Duke, G-4, Eighth Army; Col. Mabry G. Miller, G-4, Eighth Army Support Command, and Col. John Grant, Signal Officer, First U.S. Army Corps.

The speaker for the evening was Grant Whiteman, deputy director of the Office of Economic Coordination for Korea, who described the role of the Office of Economic Coordination with particular reference to the program for Korean self support. A veteran of many years of experience in the Far East, Mr. Whiteman emphasized the need for stimulating Korean economy and described the several programs that have been initiated to accomplish this task.

Lexington

In a speech at the October-November meeting, Maj. Gen. W. Preston Corderman, Deputy Chief Signal Officer, praised the organization as "an indispensable reservoir of know-how and experience."

Speaking to the group at a dinner-meeting at the Lexington Signal Depot, the General stressed the importance of co-operation between the Armed Forces and civilian enterprise.

General Corderman, speaking of the reorganization of the local group, praised Jack Davis, Bill Jordon, Harry Huether and Byron Cracraft as men who "remained stalwart members of the Association during the few lean years and were on hand to spark the rebirth of the Lexington Chapter."

Commenting on the defense program, the General stated that the "ever present danger of a shooting war makes it imperative that the civilians on duty at armed forces installations, scientists in the universities and laboratories, and the people in industry and commerce work in unison on the defense effort."

He stated that the notion "that war can be quick and relatively painless" is a fallacy. "Push-button warfare is not here," the General declared, "there is no super-weapon guaranteed to achieve victory.

"In this connection," he said, "the Army recognizes the need for versatility and has made a major reappraisal of the way the army of the future may fight."

The future army will fight on an atomic battlefield "vastly increased in depth," with widely dispersed units. Consequently, the victory will come to the side possessing superior mobility to exploit the effect of weapons with greatly decreased fire power. Units of the future will be "semi-independent and self-contained," he stated.

"With the increased emphasis on control of widely dispersed units, the importance of communications has increased greatly," he added.

Approximately 150 members, their guests, and conferees, who were at the depot for a conference, attended the meeting.

Maj. K. J. Holmes, chapter president, introduced to the group, Mr. Edward J. Brown, Jr., and Mr. Raymond Soard, Jr., who recently were elected first and second vice presidents of the chapter.

London

For its October meeting, the chapter visited the Research Station of the General Post Office at Dollis Hill.

The group was taken by guides to see the experimental facilities of the station. Brief explanations were given about some of the projects being carried on there. The British part of the experimental work on the transatlantic cable which was developed at Dollis Hill was also explained to the members.

After dinner, the program of the research station was further outlined by

the Controller of Research, G. J. S. Little, C.B.E., G.M. He and his colleagues answered questions and discussed special projects with members who had specific interests. Brig. L. H. Harris, C.B.E., a chapter member, also answered particular questions.

Louisiana

Brig. Gen. Paul L. Neal, communications consultant, Government Relations Dept., Western Union Telegraph Co., was the guest speaker at the chapter's December meeting.

General Neal, who spoke at three chapter meetings in the Southwest, encompassed in his speech an evaluation of record communications from the days of Morse to the present time. He also gave a crystal ball look at the future of record communications.

For a further report of the General's speech, see news of the South Texas Chapter and page 67.

New York

Dr. John P. Hagen, project director of Vanguard for the Naval Research Laboratory was the guest speaker at the October 31 meeting.

Colonel Percy G. Black, AFCEA national president, gave a brief report on the continued growth of the Association. He stated in this report that the Association's membership is well over 9,000 and that it is still growing.

Dr. Hagen addressed the meeting on "The Earth Satellite Program." Using colored slides, he described the background for this scientific program to be held during the International Geophysical Year.

He explained that the satellites to be used to gather scientific data about the upper regions surrounding the earth will be launched by means of three-stage rockets. Dr. Hagen described these satellites as approximately 20 inches in diameter and as weighing about 11 pounds.

Dr. Hagen stressed that radio communications will play a most important part in the Earth Satellite Program because they will be depended upon to transmit data from the satellites to the various scientific laboratories established to record and analyze the information.

The speaker of the evening at the chapter's November 28 meeting was Maj. Gen. J. D. O'Connell, Chief Signal Officer of the Army, who spoke on "The Army in the Missile Age."

General O'Connell's talk was interspersed with film clips, illustrating the many new weapons and missiles and many of the electronic devices for "Command Control" used by our modern army.

To complement this equipment, he stated that the Army needs intelligent, competent service personnel. To illustrate his point, he introduced Sergeant First Class William Ames of the New Equipment Devices Section of SCEL at Fort Monmouth. The General said that Sergeant Ames, a Bronze Star combat infantryman of World War II, was typical of the modern career soldier-technician the Signal Corps has been developing.

North Texas

Brig. Gen. Paul L. Neal, consultant, Government Relations Department, Western Union Telegraph Co., spoke before chapter members December 7.

General Neal, who gave a series of addresses to the Southwest AFCEA chapter, showed the group a collection of slides illustrating his talk. The slides included pictures of the latest Western Union equipment as the receiving and transmitting positions at United Air Lines, a typical torn tape console and the Ticket Fax, main office equipment. For further notes on his speech, see South Texas news.

Northwest Florida

Floyd H. Gleason, Collins Radio Co. engineer, presented the Collins Integrated Flight Display to chapter members at a dinner-meeting, November 15.

Maj. Gen. James D. O'Connell, Chief Signal Officer, who was guest speaker at the New York Chapter's November meeting, is shown with Chapter President S. F. Patten and Col. Arthur A. McCrary, CO, Army Pictorial Center.

Lexington Chapter's October meeting was addressed by Maj. Gen. W. P. Corderman, Deputy Chief Signal Officer. Pictured with General Corderman are five members of the original Kentucky Chapter who were active in its reorganization as the Lexington Chapter. Left to right, Byron E. Cracraft, Bill Jordan, Hubert Jones, J. H. Davis and Harry J. Huether.

Mr. Gleason opened his presentation with a brief historical sketch of navigational aids and traced the advances in design, which have been necessary because of the ever increasing speed of flight, to the present day integrated flight instruments.

He then pointed out that the reduction in the number of flight instruments is of primary importance especially for pilots of high performance aircraft.

Orange

James E. Gardner, executive vice president, Wilcox Electric Co., was the principal speaker at the chapter's November meeting.

Speaking on the technical advances of communications and electronics, Mr. Gardner discussed engineering, development, design, and manufacture of the modern "black box." He stated that while tremendous strides have been made in the capabilities and dependability of electronic devices, they, like all things, are not perfect.

In his speech, Mr. Gardner stated that the AFCEA was the best platform to provide a meeting ground for the suppliers and the users, and that through the AFCEA, a more positive check on the source of supply of communication and electronic engineers and technicians could best be kept.

Pittsburgh

"Two Modern Miracles," an illustrated demonstration of two of the greatest scientific achievements of our time, Direct Distance Dialing and the guided missile, Nike, was presented to chapter members on October 18 at the Bell Telephone Building.

R. G. Fithian, sales manager of Bell Telephone Co. of Pa. in Pittsburgh, presented the lecture-demonstration which showed how essentially the same equipment and techniques, which automatically pinpoint the one telephone you want to reach out of the 56 million telephones now in service, will, should war come to us, assist in finding and destroying enemy bombers before they unleash their devastation on our larger cities.

A comprehensive tour through the Westinghouse Research Laboratories was arranged with the help of John C. R. Kelly, Jr., manager of the Technology Department, for the chapter's November meeting.

The trip enabled chapter members to see into the electronic future through the eyes of Westinghouse.

Rocky Mountain

The following slate of officers for 1956-1957 was chosen at the chapter's last meeting: president—Bryon E. Thady, Mountain States Telephone Co.; vice presidents—Marion F. Sanders, Hq., Air Defense Command; Lt. Col. Sam Jacks, USA, and Capt. Arthur A. Fox, USAF; secretary—Capt. F. D. Tappin, USAF; treasurer—Capt. B. L. Shelton, USAF; directors—Lt. Col. C. A. Baril, USAF; Maj. D. W. Camp, USAF; Maj. J. W. Claney, USAF;

Six admirals were among the New York Chapter members who greeted Dr. John P. Hagen, project director of Vanguard for the Naval Research Laboratory, and Percy G. Black, National AFCEA President, at the October meeting. Left to right are: Rear Adm. Roy W. M. Graham; Rear Adm. Leslie A. Knisken who was host to the chapter as commander of the New York Naval Shipyard; Rear Adm. Stanley F. Patten, chapter president; Dr. Hagen; Col. Black; Vice Adm. Walter S. Anderson and Rear Adm. Ellery W. Stone. Also present but not in the photograph was Rear Adm. William C. Organ.

Maj. R. J. Steamer, USAF; D. A. Doty, Philco Corp; J. L. Faber, Mountain States Telephone Co.; M. M. Mintz, D and M Electronics Corp.; Warren Moser, Philco Corp.; J. M. Shepherd, Mountain States Telephone Co.; G. M. Ward, Jr., Radio Corporation of America.

Rome-Utica

The atomic age and its impact upon "Communications in Underseas Warfare" was the topic of the lecture delivered by Frank C. Lynch, operations research manager of the General Dynamics Corp., Electric Boat Division, at the chapter's October meeting.

Mr. Lynch, a retired Navy captain in the submarine service, vividly traced the history of the submarine from its earliest conception by Leonardo Da Vinci to its present atomic day appearance as represented by the *Nautilus*, the first atomic-powered submarine, produced by the General Dynamics Corp. shipyards at Croton, Conn.

A movie covering the construction of the *Nautilus* and its launching, which was produced by the corporation, was shown after the lecture.

Some 75 persons heard a talk and saw a film dealing with communications cable at the chapter's November meeting.

E. Mark Wolf, assistant chief engineer at Rome Cable Corp., was speaker. He showed a film entitled, "Cables —Pathway of Power," and briefly reviewed the history of the communication cable, its development and manufacturing.

He pointed out that it is surprising to most people that until early in 1956 when the transatlantic telephone cable was put into operation, all transatlantic telephone communication was via radio.

"Prior to this year, a cable capable of fulfilling this requirement was not available," he explained.

Seattle

W. T. Harrold of Radar Engineers, Inc., discussed and demonstrated a Cable Fault Finder Set developed and manufactured by his company at the chapter's November 14th meeting.

The Cable Fault Finder, a small, compact unit with a range of 200 feet, is designed specifically for detection of faults in electrical and communication cables on shipboard and aircraft. Operating on the radar principle, with irregularities in cables being indicated on a calibrated scope screen, it can detect openings and shorts, and can be used to check impedances.

Scott-St. Louis

Robert I. Colin, assistant to the vice president and technical director, Federal Telecommunications Labs, Nutley, N. J., was the guest speaker at the chapter's November 2 meeting.

The subject of Mr. Colin's speech was "TACAN Radio Bearing and Distance System for Aerial Navigation."

An expert in the field of radio navigation, Mr. Colin has had first hand familiarity with the development of TACAN.

Southern Connecticut

The first meeting of the new season for the chapter was held on November 7th in Bridgeport, Connecticut.

The highlight of the evening was a talk by Mr. Robert A. Curran, vice president and chief engineer for Insulated Circuits, Inc., on the general subject, "New Advances and Techniques in Printed Circuits."

Mr. Curran described some of the new advances and some of the new possibilities available to those interested in using printed boards. Advantages which include cost reduction, miniaturization, and the possibility of mass production on short notice were all cited. As one example of simplification, Mr. Curran mentioned a case wherein an order for the design and production of one new printed board replaced what had previously been accomplished by the issuance of twenty-seven individual purchase orders. Although still in the developmental stages, the possibility of automatic assembly is envisioned for the near future.

South Texas

At the chapter's December 5th meeting, members and guests heard Brig. Gen. Paul L. Neal's speech on "Record Communications" at the Fort Sam Houston Officers Club.

In his timely lecture, General Neal, who is consultant, Government Relations Dept., Western Union Telegraph Co., discussed the past, present, and future of Record Communications.

In speaking of its history, General Neal said, "The evolution of telegraphy has been typically American in that it never followed a middle-of-the-road path. Morse's first receiving machine was a recorder printer which printed the dots and dashes of the Morse Code. Operators soon learned to interpret the sounds made by the recorder and converted them directly to writing and thus created the profession of 'telegraph operator.' The recorders were junked and for many years the key and sounder ruled the roost. The evolution of the keyboard teleprinter, utilizing the five unit Baudot Code, has swung the pendulum back to recording methods as standard practice."

General Neal also thoroughly discussed the future. He noted that "Facsimile transmission from the sender to the addressee would be an almost ideal method of handling record traffic. Banks are now using it for signature and balance verification between main offices and branch banks. Personal messages could be in your own handwriting and business traffic could include sketches, tabular forms of any sort, and authentic signatures."

Officers for 1956-1957 season were elected at this meeting. They are as follows: president—Col. Albert J. Snider, 1822 AACS Group Commander; vice presidents—Lt. Col. Carl O. Duncan, Deputy Chief Signal Officer, 4th Army; Branch T. Masterson, Hearst Advertising Service, and Ralph N. Ness, Graybar Electric Co.; secretary—S. J. Keane, Southwest Research Institute; treasurer—Capt. Blaine B. Shockey, U.S. Air Force Security Service; directors—Maj. Gen. Harold H. Bassett, U.S. Air Force Security Service; Maj. Gen. Harry Reichelderfer, Deputy Commander, 4th Army; Col. George Richon, Signal Officer, 4th Army; Charles Albach, Western Union Telegraph Co.; Henry S. Dunn, Base Communications Office, Kelly AFB; Ben Givens, Southwestern Bell Telephone Co., and S. H. Simpson, Jr., Southwest Research Institute.

Tinker-Oklahoma

At the October meeting, the principal speaker was Dr. Ronald B. Shuman who gave an address on "Automation, What It Will Do To You."

Dr. Schuman, who is a research professor of management, University of Oklahoma, stressed that automation is not a new or coming thing, but that it has gone hand-in-hand with the dynamic technological advance associated with the industrial revolution. He presented a broad picture of the effects of automation on our economy, labor, management, and the United States citizen in general.

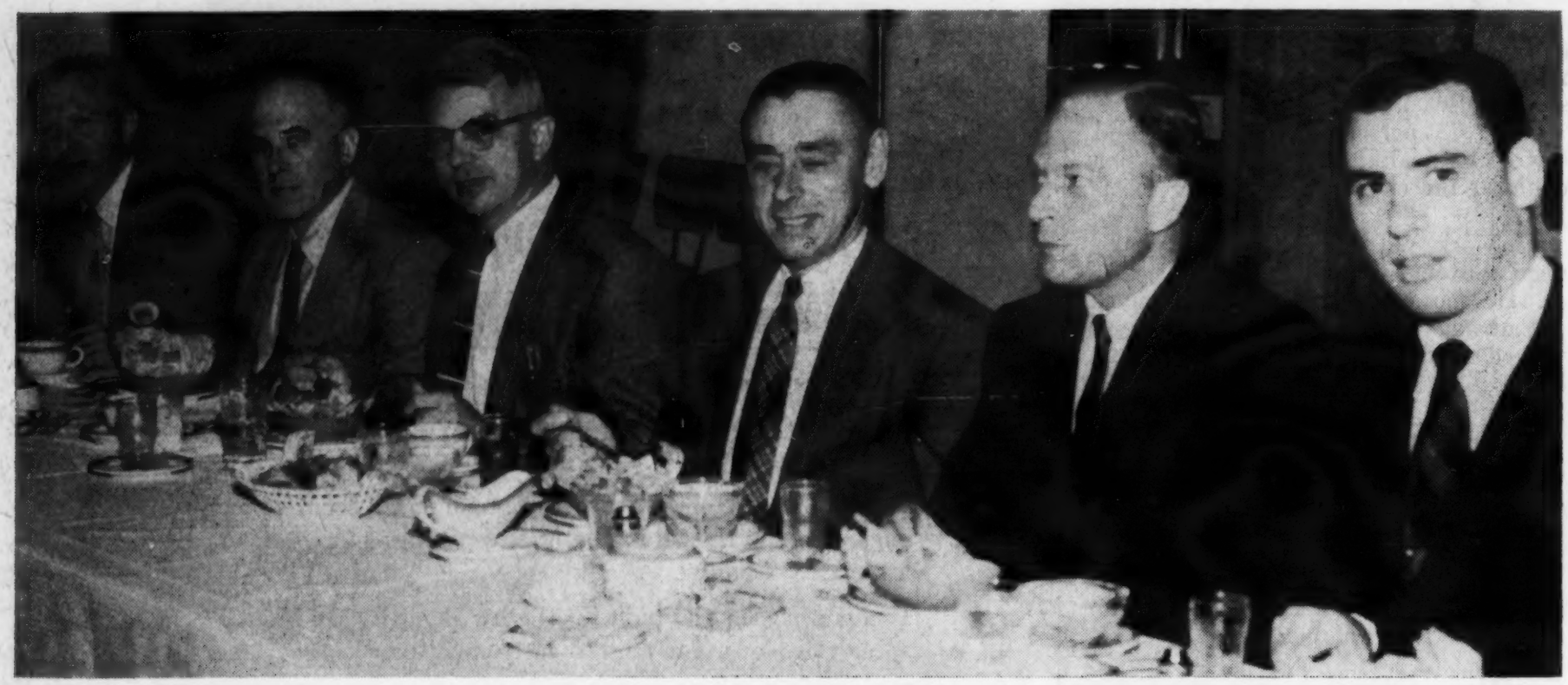
At the close of the meeting, the members and guests were able to see a display of some of the late communications, photo, and electronic gear demonstrated. The display was furnished by the Southwestern Bell Telephone Co. and the Dorsett Labs., Norman, Oklahoma.

Otis Howard, manager of operations, Oklahoma Gas and Electric Co., was the principal speaker in November.

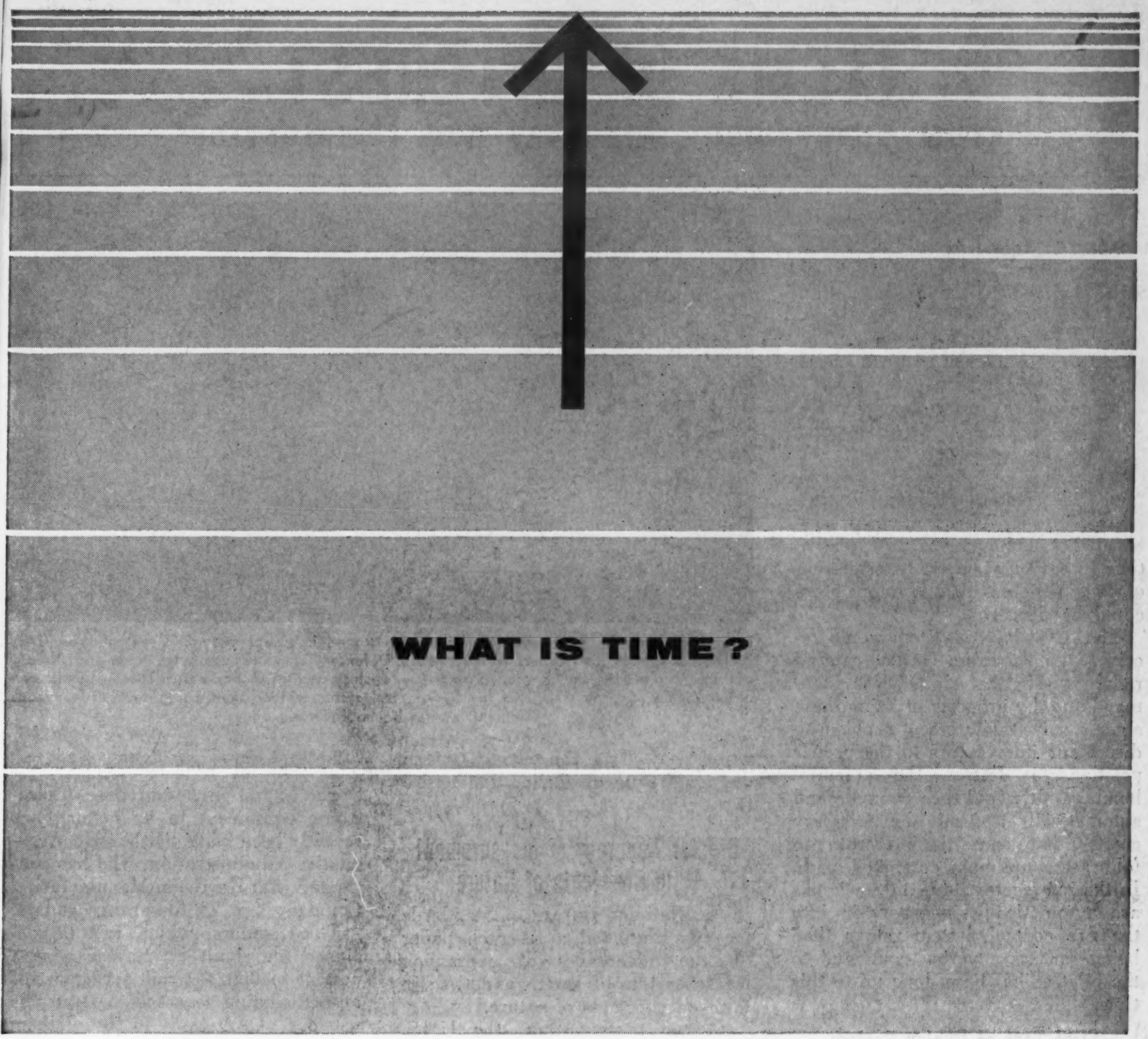
An outstanding authority on the peaceful uses of atomic energy in generating electric power by the process of nuclear fusion and fission, Mr. Howard spoke on "Atomic Energy in Power Generation." He discussed the plans concerning the construction of a nuclear power generator in the Southwest.

Washington, D. C.

Members of the Washington Chapter met on December 6th at the Willard Hotel in Washington, D. C. Guest speaker was Rear Admiral J. H. Sides, USN, whose speech can be found on Page 19 of this issue.



Head table at Scott-St. Louis Chapter's November meeting. Left to right: Allan L. Eisenmayer, chapter secretary; Robert I. Colin, Assistant to the Vice President and Technical Director, Federal Telecommunications Laboratories, who addressed the chapter on TACAN; Chapter President Walter W. VanSkiver; Louis E. Dechant, chapter director; and Richard W. Hilgard and Louis E. Dechant, Jr., guests.

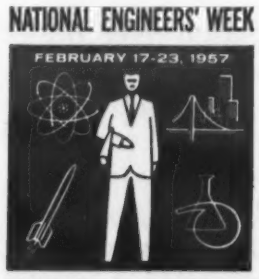


WHAT IS TIME?

Anything that can be postulated is possible, says science—including *timelessness*.

The latest table-talk among the rocket and missile men has to do with the physics (and metaphysics) of photon propulsion: thrust for a space vehicle derived by shooting incredibly concentrated beams of light (photons) from its tail. Result—speeds approaching that of light! Round trips to distant galaxies could thus be accomplished in a single generation of the crew. Meanwhile, however, the Earth would have passed through a billion years—possibly into cosmic oblivion!

The space-time ratio is increasingly a factor in the calculations of a brand new field of science known as astronautics...Work in this field at Martin is already at the threshold of tomorrow.



MARTIN

BALTIMORE · DENVER · ORLANDO

ITEMS OF INTEREST
From Government, Industry and the Services

New Intercept System

A new ground control intercept system to provide the United States with improved air defense capability has been developed by the Heavy Military Electronic Equipment (HMEE) Department of the General Electric Company.

Nomenclature for the system is the AN/GPA-37 Radar Course Directing Group. The equipment operates on the principle of "electronic automation." This factor is increasingly important to Air Force intercept systems where human error, or excessive time in computation, or transmission of control signals to our interceptors could be disastrous.

The AN/GPA-37 system would receive signals from large ground radars within the Air Defense Command and, by properly utilizing these signals, solve the intercept problem to direct our interceptors to the proper position to destroy the potential bombers. It would then compute and automatically transmit the necessary commands to cause the interceptor to follow the optimum computed path. In the interceptor itself, these signals are automatically incorporated into the fire control system rather than being sent as a verbal command to the pilot as has been done up to this time.

Displayed above is the operation of the new ground intercept system. Developed by G-E, it receives signals from radars within the Air Defense Command, computes them and directs our interceptors to the proper position to destroy potential bombers. These signals are automatically incorporated into the fire control system rather than being sent as a verbal command as has been previously done.

First Test of Dualex System

The demonstration of the marine Dualex alerting and selective signaling equipment has recently been held on the Great Lakes. The two week project was undertaken through the study on marine radio alerting and call selectors which Congress has ordered.

Dualex, the first system of marine automatized radio record communications, consists of a two-tone tape printer and a digital selective calling system. It was praised as having been totally effective and giving no fal e alarms during the period of observations of the tests on the 500 KC distress frequency up to distances of more than 200 statute miles. The unattended printer has an automatic transmission capacity of up to 120 words per minute.

It was noted that the cargo ship, *John C. Munson*, used the Dualex system for communications of the vessel as well as the testing on the distress frequency during the entire two weeks.

Greater Accuracy of Measurement With Constants of Nature

The National Bureau of Standards recently presented a research paper on the advantages of expressing measurements of length and time in terms of constants of nature.

At the present time, the U. S. standard of length is a platinum bar one meter long kept at NBS. This bar has proved accurate to within about three parts in 100 million but it is believed that even greater accuracy is possible with wave lengths of light. They have a comparable precision of about one in a billion and it would be relatively simple to establish the unit of length any place in the world. The paper suggests that the red light from a cadmium atom would be an excellent yardstick and the precise measurement of length would be so many spectral lines per meter.

The calculation of time, based on the earth's rotation on its axis, has shown some slight variation over the years. To obtain a constant of nature as a base for calculating exact time the scientists turned to the cesium atom. Atomic vibrations are extremely stable and time could be expressed with a high degree of accuracy in terms of frequency per second.

Contract for Long-Range Radars

The largest single purchase of electronic equipment in its history has recently been made by the Civil Aeronautics Administration, who has contracted with Raytheon Manufacturing Company for 23 long-range radars.

These radars, which will be designed and built by Raytheon at a cost of $9,000,000, will form part of an expanding coast-to-coast traffic network. CAA plans to install them at 23 of their 28 locations across the country. Information from military radars will be used at the remaining 5 locations.

In addition to this, approximately $21,000,000 was obligated for new air navigation and traffic control facilities during the fiscal year beginning July 1, 1956.

"Milking Machine"

An investment of $900 for an automatic defect-finding machine has saved the U.S. Signal Corps about a quarter of a million dollars. The Lewyt Manufacturing Corporation has developed and built the machine in an effort to reduce costs.

The "Milking Machine," so called because of its many electric cables that reach down from the equipment's "belly" for test work, saves up to 57 percent of labor required for the testing of intricate Signal Corps transmitters and receivers. It insures a

E. H. RIETZKE, President CREI
Capitol Radio Engineering Institute

• One of a series of institutional messages

The President of CREI asks:

"You can lead a man to knowledge . . . but how do you make him think?

CREI Technical Courses Now Mold Desirable Job Attitudes as Well

Since October 1, 1956, CREI has included in all its technical courses a section on Leadership training administered by the Holmes Institute Division of CREI. The names of these courses are: "Moving Ahead On the Job" . . . "The Techniques of Handling People."

From the point of view of student acceptance, this has been probably the most successful addition ever made to CREI's accredited technical institute curricula in our 29 years of training technical personnel for industry and the military service. More than 5,000 students already have been enrolled under this new plan.

From yet another point of view — management's search for attitudes of cooperation and leadership — this addition has been most successful. These men are not only becoming better technical men —*they are also becoming better employees!*

Mr. Electronics Executive: Mr. Military Officer: Wouldn't you like to have your technical personnel do this kind of thinking?

*(An actual statement taken from the examination paper of a CREI student—a man with 12 years of professional experience in electronics)**

"When I first started this course, I thought to myself: Why everyone knows these things. After the first chapter or so, I decided that maybe there was really something here that I could use. So I stepped back and took a look at myself. What I saw I didn't like too well. I then went back and started reading again from the beginning. As I went, I checked all of the guide points and the 'do's and don'ts.' It surprised me to find out that upon being truthful with myself, I came out about 50-50. I have made a list of things I have to watch out for and the traits I want to improve or get rid of completely. This list I intend to follow and do my best to improve.

"I wish to say at this time that this is the first time in a good number of years that I have found a course in leadership which was written for people like me who really do need the help; most courses are just a bunch of ideas; this course anyone can understand. I think I have learned much and hope I can put into practice what I have learned."

**Name on file*

We believe the words of this student best describe to you our new training program. In teaching *Leadership,* and getting men to THINK, CREI is supplying that *extra plus* that makes a man more than a good technical man. CREI graduates will have the ability and concept to think above and be interested beyond a particular job assignment. For detailed information about this, or any other phase of CREI's Home Study or Residence program, and how it can help with your technical manpower or training problems, please write directly to: E. H. Rietzke, President.

FOR YOUR SUPERVISORY TRAINING:

The Leadership section described above is also available separately, in complete form, for your own training of supervisory personnel. Details will be sent on request.

CAPITOL RADIO ENGINEERING INSTITUTE

FOUNDED IN 1927

ECPD Accredited Technical Institute Curricula

Dept. 211-D 3224 Sixteenth St., N.W., Washington 10, D.C.

uniform yardstick for testing, which eliminates human error. Using an approved transmitter or receiver as a standard unit, the machine compares circuit with circuit, with defects clearly indicated to the tester.

More than 50,000 man hours, representing about a quarter of a million dollars, have been saved for the Signal Corps by using the machine. The equipment has tested more than 30,000 transmitters and receivers, ordered in multi-million dollar contracts.

New Radar for USS Gyatt Terrier

The Terrier Missile System installed aboard the *USS Gyatt*, the Navy's first guided missile destroyer, combines for the first time a gun fire control system with radar guidance equipment.

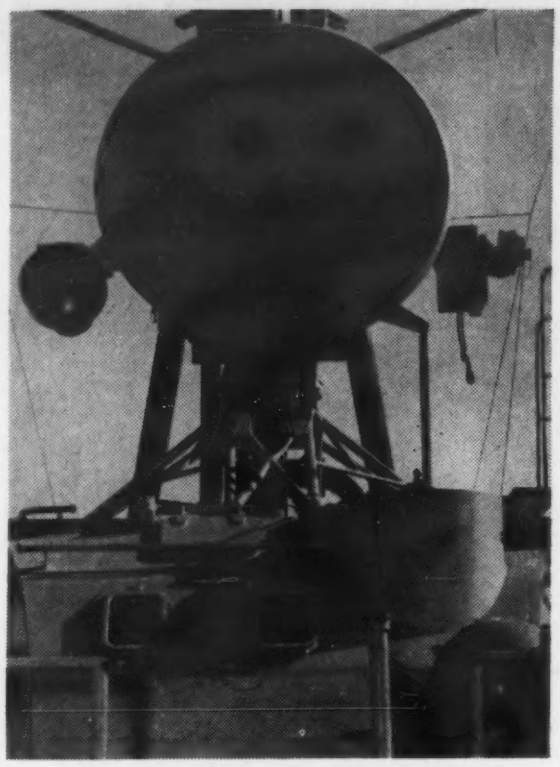
A slim needle-nosed supersonic weapon, the "Terrier" is designed to intercept aircraft under all weather conditions night and day. While similar to the radar guidance equipment previously designed and built by Reeves Instrument Corp. for the "Terrier" systems installed aboard cruisers, it is more compact, has greater range and precision, is capable of self-monitoring and requires fewer men for its operation..

When the approach of an unidentified plane is indicated on the radarscope, certain signals are generated which identify the plane as friend or foe. If the approaching aircraft is identified as an enemy plane, the radar continues tracking the target, and relays necessary information to the missile launching computer for the firing of the missile being used to shoot down enemy planes. A closely interrelated data system between the radar, the launcher, and the missile itself then shoots the missile into the radar beam and the missile is guided by the radar to intercept and destroy its target.

New Picture Making Technique

A new photo sensitive plastic which could be used militarily for printing photographs in areas affected by atomic radiation has been developed by the Army Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey.

Ordinary photographic papers tend to fog under nuclear radiation but the new plastic is almost unaffected by gamma rays and therefore has a particular military value for use in "hot" areas. Pictures made by using the plastic process are clear, durable, waterproof and are stronger than today's paper prints.



New "Terrier" Radar for Gyatt.

The process, discovered by the Ferro Chemical Company of Bedford, Ohio, offers other important military advantages: No water is needed and only a limited amount of equipment is required in the new system; neither chemicals nor a darkroom are required; a sunlamp takes the place of an exposure light and an oven replaces the trays of hypo and developing solution; and total developing time is five minutes.

To produce a plastic print, an aluminum plate coated with a special vinyl is placed under a negative, as in conventional printing. It is then exposed to strong ultraviolet light for five seconds. The light rays from the mercury-arc lamp burn an invisible image into the plastic. Baking at 320 to 350 degrees Fahrenheit brings out the picture. In five minutes, the plastic can be stripped from the metal as a finished print.

Developing paper used by photographic laboratories today must be handled in the dark or in dim amber light. However, Signal Corps scientists at Fort Monmouth develop their plastic pictures in a "darkroom" with the lights on. Since the vinyl is sensitive only to ultraviolet, it can be exposed safely to the electric lights of an ordinary room.

New Signal Corps Microfilms

Microfilm "windows" in tabulating cards, used for transmitting engineering drawings, are expected to save nearly a half million dollars annually in the Army Signal Corps procurement program. The special machines used in this process are built by Recordak Corporation.

Over 300,000 engineering drawings have been microfilmed at Fort Mon-

mouth, N. J. Positive film prints, made from the original microfilm negatives, are being mounted in the tabulating aperture cards. They will be distibuted to various Signal Corps installations for reference in repair and overhaul of signal equipment and for procurement purposes.

Shown above is the new microfilming process used by the Army Signal Corps to transmit engineering drawing. Positive film prints are mounted in the tabulating aperture cards.

They will be used to make reduced size paper prints to use in issuing bids to industry. The new system replaces the old costly method of making full-size paper reproductions of drawings.

U. S. to Spend Record Sum for Defense Next Year

The American citizen's defense bill for military spending next year will be the biggest yet under the Eisenhower Administration reports the December issue of *Fortune* Magazine.

Even before the recent upheavals in Eastern Europe and the Middle East, the Administration was resigned to an outlay of about $38 billion during fiscal 1958, an increase of $2 billion over current fiscal 1957 expenditures. Now, confronted with a newly threatening world situation, coupled with deep-seated dissatisfaction with their allotments by all three military services, and a Service-minded Democratic-controlled Congress, President Eisenhower may find it necessary to spend even more than that. The services' own "flash" estimate of their next year's needs is 48.6 billion.

Two factors in particular account for the rise in the cost of national defense. First, direct cost charged to personnel is running at the rate of nearly $10.5 billion a year, or 30 percent of all Pentagon expenditures.

During 1958-60 it is expected to rise by another 35 per cent. The other factor is the extremely high cost of new weapons. In the current budget "major procurement and production" takes about $10.6 billion, with 70 per cent going just for aircraft and guided missiles.

Here are some of the particular items that will contribute to the new spending record forecast by *Fortune:*

The Air Force will spend upwards of $7 billion in the next four years on its Intercontinental Ballistics Missiles program. Costs of underground sites for launching the missiles range as high as $600,000 apiece. Sites will number in the scores.

The Army claims that to enlist one American, clothe, house and feed him, put an effective weapon in his hand and move him about the world now costs between $12,000 to $13,000 a year, and will soon rise to $16,000. Twenty years ago the cost was only $2,700.

The Navy is seeking to add nuclear propulsion to the next carriers in the *Forrestal* category. This change would raise their cost $100 million or so above the present price tag of $190 million.

The Navy and Marine Corps got nearly $10 billion for fiscal 1957, and were down for the same figure next year. Now the Navy maintains it ought to have $13 billion.

Ballistic-Launching Ship Commissioned

The U.S. Navy's experimental ship, *Compass Island*, forerunner of a fleet of nuclear-powered, ballistic missile-launching vessels, was commissioned recently.

A converted Mariner-class cargo vessel, the *Compass Island* is being equipped with "the most fantastic array of navigation instruments ever assembled in a ship," the Navy said. Its mission is to speed evaluation of new inertial aids for precise mid-ocean navigation and to expedite launching of the Fleet Ballistic Missile.

The ship's inertial navigational system (SINS) is the key to its all-weather, all-latitude, day and night capability. This system, which also includes celestial trackers, is a new development of the Navy's Special Projects Office of the Bureau of Ordnance and Sperry Gyroscope Company. The system determines ship position (latitude and longitude), true North, and the ship's speed over ground.

The ship uses an electronic star tracker. There is a dome on the navigation tower which resembles a small observatory. On this is set a telescope which requires no observer —where the human eye would normally play its part is a photo-electric cell, so sensitive that stars become visible in daylight.

Sperry Gyrofin ship stabilizers are also utilized on this ship. This stabilization is of extreme importance to the launching of missiles. While sister ships may be rolling 15 degrees, *Compass Island* will roll about a degree and a half. This is accomplished by underwater fins, one on each side of the vessel, approximately midway between bow and stern. The action of the fins is automatically controlled from the bridge by instruments which measure roll rate, roll angle and roll

Pictured on the right is a Sperry Gyrofin ship stabilizer which is being utilized on the Navy's experimental nuclear-powered, ballistic missile launching vessel, the Compass Island. The Gyrofin is very important to the launching of missiles. While sister ships may roll 15 degrees, Compass Island will roll only a degree and a half. This fin is placed midway between bow and stern on each side of the vessel and its action is controlled automatically from the bridge.

acceleration. Gyrofin continuously computes the proper stabilizing moment and by its unique lift control feature assures accurate application of the stabilizing moment to the ship. These compact sensors then transmit, through magnetic amplifiers, the required anti-roll signals to hydraulic actuators which directly operate each fin shaft. The fins may be retracted into recesses in the hull when not in use.

"PAGEMASTER"

Members of the staff of Strong Memorial Hospital, New York, are being paged quietly and individually through a new "Pagemaster" selective paging system, manufactured by Stromberg-Carlson, a division of General Dynamics Corporation.

With this system, the individual doctor or other staff member carries in his pocket a small radio receiver, about the size of a pack of cigarettes. This receiver is tuned to respond only to a certain coded signal. When that signal is received, the device emits a clear buzzing sound, which informs the person carrying that particular receiver that he is being paged. He then steps to the nearest telephone, identifies himself to the operator, and receives the message.

The paging signals are broadcast from a small radio transmitter, with its control panel, or "encoder," located at the hospitals' telephone switchboard within easy reach of one of the operators. Four different numbers can be set into the encoder simultaneously, and the transmitter continues to broadcast each of them in turn until the number is switched off.

Personnel

General Reichelderfer Retires

Major General Harry Reichelderfer, Fourth Army Deputy commander, whose distinguished military career of almost 40 years was highlighted by service as a Signal Corps officer, retired November 30th at Headquarters Fourth Army.

His outstanding service in the Signal Corps has included the post of Sixth Army Signal Officer in World War II during the operations of the Sixth Army from New Guinea to Japan. After the war, he served for a brief period in the Office of the Chief Signal Officer, Washington, D. C., and then was assigned as Army Field Forces Signal Officer, Fort Monroe, Va. He later left there to assume command of the Signal Corps Training Center, Camp Gordon, Ga., which he reactivated.

In 1949, Brig. Gen. Reichelderfer became Commander of the Signal Corps Engineering Laboratories, after which he became Commander of the Signal Corps Center at Fort Monmouth, N. J.

In 1953, he assumed command and established the Southwestern Signal Corps Training Center at Camp San Luis Obispo, Calif., and the following year he was given the command of the Army Security Agency, Washington, D. C. This appointment preceeded his last assignment.

Dr. Crenshaw Made Chief Scientist

It was recently announced that Dr. Craig M. Crenshaw has been appointed Chief Scientist for Signal Corps Research and Development. His former position was that of Director of the Physical Sciences Division, Evans Signal Laboratory, Fort Monmouth, N. J.

Dr. Crenshaw was a Graduate Assistant at New York University where he received his Doctor of Philosophy degree in nuclear physics. The data he collected there was adapted as world standard for low energy end of nuclear Range-Energy relation. He is also the author and co-author of numerous scientific and technical articles.

In 1942, he accepted the position of physicist with the Signal Corps Engineering Laboratories at Fort Monmouth. He directed Experimental Groups there for field operations of Operations Crossroads, Sandstone and Greenhouse.

Hudgins New Executive Officer At Training Device Center

Commander William D. Hudgins has been named Executive Officer at the U.S. Naval Training Device Center, Sands Point. He will also serve as Administrative Director of many of the Center's key departments among which are Administrative Services, Industrial Relations, Public Works, Supply and Contracts.

Commander Hudgins has enjoyed a varied naval career and has filled several important billets in the past. During World War II he served as Radio Material Officer at the Naval Operating Base, Trinidad, British West Indies, where he was responsible for construction of major communications stations.

His former post was that of Commanding Officer of the Bureau of Ships, Industrial Manager Organization in San Juan, Puerto Rico. Here he directed and allocated ship repair and shore electronics construction work.

PERSONNEL CLEARING HOUSE

AFCEA Members Available to Industry

The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ——, SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

DISTRICT SALES MANAGER OR FIELD REPRESENTATIVE for electronics or associated firm. Excellent contacts with industry and Government agencies in 11 Western states. Fully cognizant of Western industrial expansion. Familiar with all Western Government projects and R&D operations. Capable of setting up Western office, advertising program, marketing, distribution program. Box 120.

SALES ENGINEER: ADVERTISING—SALES PROMOTION MANAGER. Recent sales experience plus 10 years' experience in advertising and sales promotion of electronic products. Radio amateur for over 20 years. Age 37. Engineering education of 3 years and B.S. in Marketing degree. Prefer West or East coasts. Box 121.

COMMUNICATIONS SPECIALIST—COMMUNICATIONS SYSTEM MANAGER with leased long-line interphone experience plus 10 years military and civilian air traffic control. Broad background in electronics, air operations, and flight movement. AB and LLB degrees. Will consider any location. Box 122.

Government and Military Positions Available

Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

ORDNANCE ENGINEER ($7,000/year). Assistant Inspector of Naval Material, Germantown, Pa., has opening in development and production of ordnance equipment. Requirements: Bachelor's degree in engineering (or four years' equivalent experience) and 2½ years' engineering experience, one in ordnance engineering. Master's degree can be substituted for one year's experience; Doctor's degree in ordnance engineering can be substituted for all experience. For further information, write: Supervising Inspector of Naval Material, 17 Brief Ave., Upper Darby, Penna.

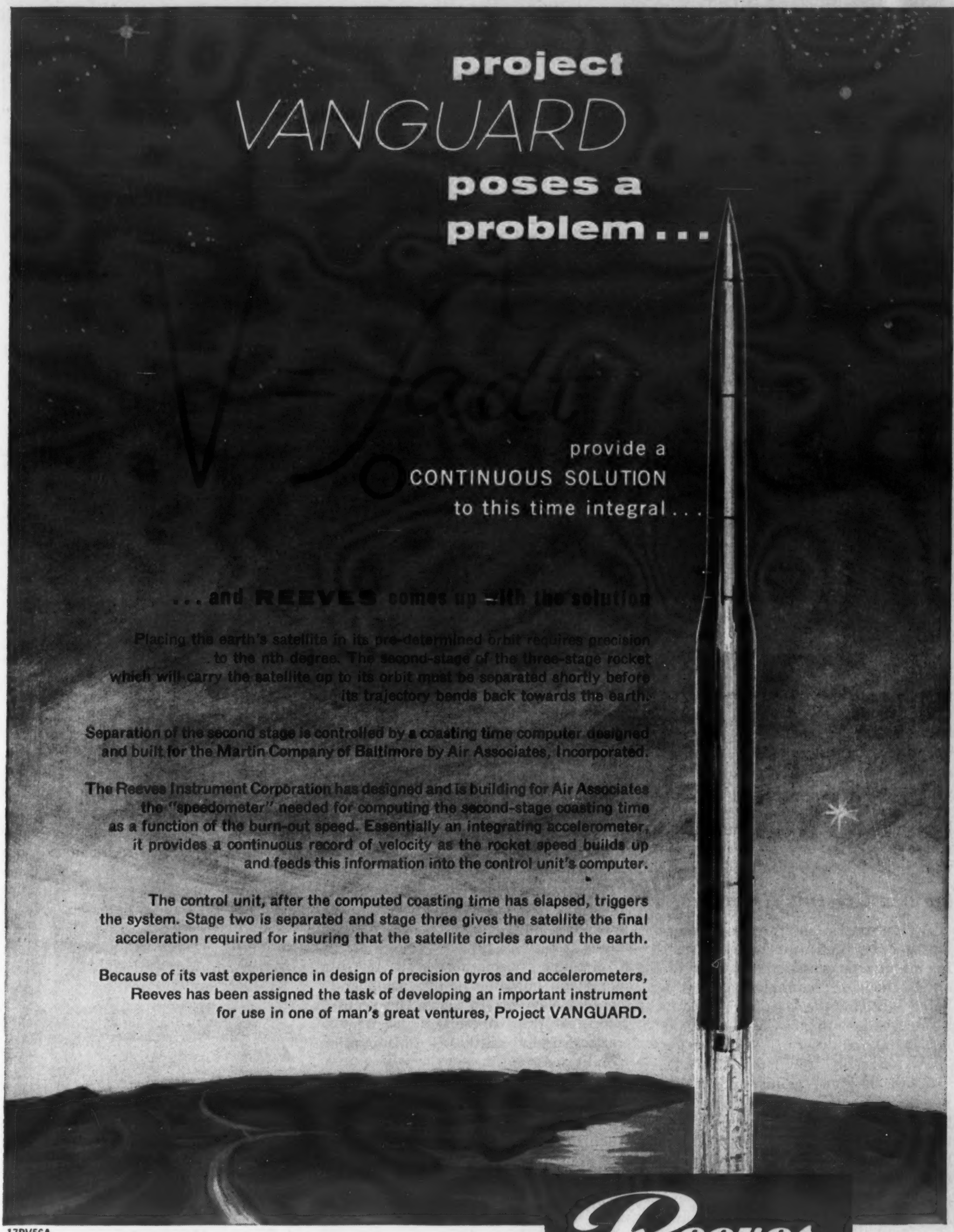
ELECTRONIC ENGINEERS, ELECTRONIC SCIENTISTS, MECHANICAL ENGINEERS, starting salaries $5,335-$6,390. ENGINEERING DRAFTSMEN, $3,415-$4,080. Vacancies now exist at the U. S. Navy Electronics Laboratory, a major West Coast scientific organization engaged in research and development of electronic equipment and systems. For further information address: U. S. Navy Electronics Laboratory, Civilian Personnel Division, San Diego 52, California.

ELECTRONIC ENGINEERS: One Electronic Engineer (telephone) and one Electronic Engineer (radio), starting salary $6,390. Requirements are: degree in electrical engineering and 2½ years professional experience, one year of which must have been in the specialized field, or 6½ years professional electronic engineering experience. Applications should be forwarded to: Hqs., 5001 SU Station Complement, 5th Army, 1660 E. Hyde Park Blvd., Chicago 15, Illinois.

THE SPECIAL DEVICES CENTER, an activity of the Office of Naval Research, located at Sands Point, Port Washington, Long Island, has several vacancies for electronic engineers at $6390 a year, and one vacancy for a general engineer at $6390 a year which requires specialized experience in audio-visual recording. Inquiries should be directed to the Industrial Relations Officer. Telephones: Flushing 7-8300 and Port Washington 7-3800.

RADIO OPERATOR TECHNICIANS. Veterans $3400-$4200 to start. Overseas opportunities. Amateur or commercial licenses helpful. Full pay during advance training. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, private training, work experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

TELETYPE OPERATORS AND CRYPTOGRAPHIC TECHNICIANS. Veterans $3200-$3700 to start. Overseas opportunities. Full pay during training period. Good advancement opportunities. Submit resume with name, age, address, phone number—if any, military experience, FCC licenses—if any. Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.



REEVES INSTRUMENT CORP. *A SUBSIDIARY OF DYNAMICS CORP. OF AMERICA,* 215 EAST 91st ST., NEW YORK 28, N. Y.

NEW PRODUCTS from Industry

EIMAC Announces Giant, Super Power Electron Tube

A giant, super power klystron, the largest electron tube ever developed, has been anounced in San Bruno, California, by Eitel-McCullough, Inc.

The new tube is capable of generating 100,000 watts of average radio frequency power and more than 1,000,000 watts of peak pulse power. It will be used in radar and linear accelerator operations. The new tube will increase the effectiveness of certain radar applications and offer new advantages to the processing of food, chemicals, plastics and petroleum.

The world's largest electron tube—a ten-foot five-inch Klystron—is measured by W. W. Eitel, president of Eitel-McCullough, Inc., manufacturers of Eimac electron tubes. The new giant super power tube will be used in radar and linear accelerator applications.

Portable ABG

An Alpha, Beta, Gamma detector has just been developed by Universal Atomics Corp., 143 E. 49th St., New York, N. Y. The all-purpose laboratory radiation detection monitor tracks down radiation dosage, leakage, accidental spillage, and contamination.

The unit can be pre-set to sound a loud warning and flash a light at a predetermined level of radio-activity, and it maintains constant vigil 24 hours a day. It reads up to 50,000 cpm and weighs six pounds. It comes with 25 feet of cable, and additional cable is available.

The instrument is encased in a lightweight, watertight aluminum suitcase (420B) or may be obtained in a sloping-front console (420A).

Quartz Crystals Critique

An automatic multi-testing device for speeding up the production testing of quartz crystals used in radio and television communications is being built for the U.S. Signal Corps by Reeves Instrument Corp., a subsidiary of Dynamics Corp. of America, 25 W. 43rd St., New York 36, N. Y.

While designed primarily for testing the types of crystals used in military communications, and especially those expected to operate under extremes of heat and cold, the multitester could also be used to speed up production and insure greater uniformity in the quartz crystal units manufactured for commercial and industrial broadcasting.

The automatic tester will encompass the whole test cycle for 100 or more crystals an hour. Under present methods of manual testing, skilled operators require fifteen to twenty minutes to check the variations in the activity and frequency vibrations of each crystal. The Reeves' te ter will have five test sockets operating simultaneously and completely automatically.

A single console houses the instrument and contains both heating and cooling elements to check the accuracies of the operating frequency ranges under all kinds of climatic conditions.

Conelrad Radio Monitor

The first Conelrad receiver which requires both carrier break and 1000 cps tone to activate an alarm is announced by Motorola Inc., Chicago, Illinois. The unit is designed to eliminate nuisance alarms caused by carrier break alone. It monitors standard broadcast stations for the Conelrad Radio Alert. F.C.C. regulations require land-mobile radio stations to make provisions for receiving this alert after Jan. 2, 1957.

A front panel switch permits the speaker to be muted for silent monitoring until an alert signal is received. Reception of the alert signal activates the front speaker, a front panel alert indicator lamp, and a pair of contacts for an external alarm device. The alarm remains activated until manually reset, assuring operator cognizance that an alert signal has been received.

Abnormal conditions are indicated separately from the Conelrad "alert" alarm by a "fail-safe" indicator lamp which lights when the received carrier is abnormally weak, entirely absent, or "on" but inoperative.

The unit plugs into any standard 117 VAC outlet. Size is approximately 21 x 9 x 12 inches and it weighs 29 pounds.

Frequency Computed in One Setting

The "Calculaide Frequency Computer," devised by American Hydromath Corp., 25-20 - 43rd Ave., Long Island City, New York, correlates in one setting the physical dimensions of the coil and the capacity of the condenser with the natural frequency and wave length of the circuit.

Inductance values can be determined for widely varying physical dimensions of coils, from high-power transmitting coils to the smallest single-layer receiver coils. The computer's range covers frequencies from 400 kilocycles to 3,000 megacycles and wave lengths from .1 to 600 meters. It handles condensers of capacity between 1 and 1,000 microfarads. It computes inductance values from .05 to 1500 micro-henrys.

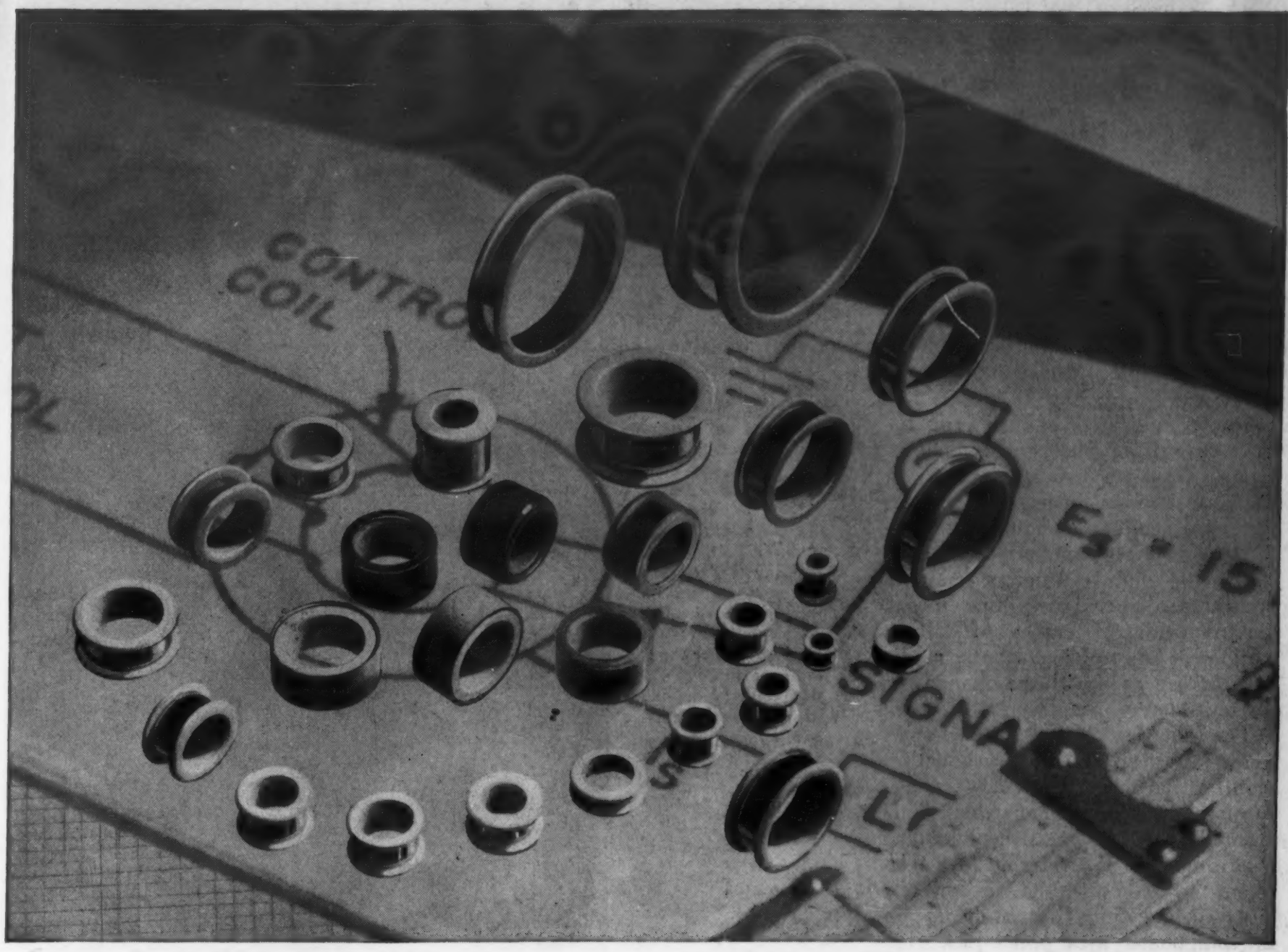
The computer, made of Vinylite plastic, is pocket sized.

Fuel Gauge Tester for Aircraft

Telectro Industries Corp., 35 - 17th St., Long Island City 1, New York, announces the availability of the USAF Type MD-1 aircraft fuel gauge tester designed specifically to test and calibrate aircraft capacitance type fuel gauges.

The MD-1 tester qualifies under A.F. Spec. MIL-T-8579 and meets all requirements of this Spec.

The tester is a direct reading variable capacitor with a range of 10 to 6,200 uuf. The mina dial and vernier dial have a positive locking de-



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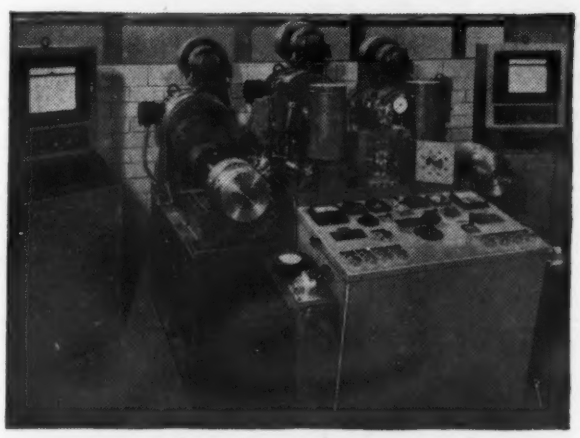

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Includes essential data on applications and properties, fabrication and testing of Arnold Bobbin Cores; lists standard sizes, etc.

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Quality and uniformity? *You'll find them no problem*—because, as a fully integrated producer with highly modern facilities, we're able to maintain close control over every step.

Arnold Bobbin Cores are available in a wide range of sizes, tape thicknesses, widths and number of wraps depending on the ultimate use of the core. Magnetic materials usually employed are Deltamax, Permalloy and Supermalloy, in standard thicknesses of .001″, .0005″, and .00025″. Core properties include quite rectangular hysteresis loops, relatively low coercive values and high saturation densities, plus the ability to shift in a few microseconds from negative remanence to positive saturation, and vice versa, under conditions of pulse excitation. • Let Arnold supply your requirements for Bobbin Cores—or other tape-wound cores, powder cores, permanent magnets, etc.—from the most complete line of magnetic materials in the industry. WSW 6300

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vice and a mechanical arrangement that eliminates back-lash.

The tester is lightweight, portable, and sealed against moisture. No external power source is required.

Plugboards to Test Aircraft

Dit-Mco, Inc., 911 Broadway, Kansas City, Missouri, announces Model 850 with plugboard multiplier to test aircraft. It is used in conjunction with the Dit-Mco Model 200 Circuit Analyzer.

The complicated circuitry of today's aircraft, missiles, and computers is undergoing constant design changes. For instance, constant design modifications and improvements in modern heavy bombers cause each ship to be slightly different from its predecessor. Previously this meant that the adapter cables of testing equipment had to be constantly modified to keep pace with the changes in the units being tested.

The Dit-Mco Model 850 enables testers to keep up with production modification without having to modify or rebuild the adapter cables. This is made possible by the plugboard programming. Comparable to a telephone switchboard, the desired circuitry connections are built up on the plugboard with phone-jack type patchcords. Therefore, the terminations of an aircraft's electrical system can be connected, with simple cables, to the terminals of the analyzer without reference to circuitry. The desired circuitry is then set up on the plugboard. The plugboard innovation offers new efficiencies and economies in testing.

Pictured here is Model 850 of Dit-Mco, Inc., an efficient plugboard multiplier developed to test aircraft circuitry. It is used with the Dit-Mco Model 200 Circuit Analyzer. The terminations of an aircraft's electrical system can be connected with simple cables to the analyzer's plugboard pictured at right, and the desired circuitry is set up on the plugboard. This enables testers to keep up with changes in aircraft circuit design without having to rebuild the tester's adapter cables.

Improved Circuit Breaker

Several significant improvements in its miniature magnetic circuit have been announced by Airpax Products Co. of Baltimore, Maryland. This breaker is specially built for use in protecting electronic equipment.

Improvements over earlier units include extending the vibration resistance. The breaker is more tolerant of fluctuations in load current due to normal variations in line voltage. This miniature breaker can replace switches on electronic equipment and provide circuit protection as well.

Ferrite Yoke Cores

A new ferrite "full-round" deflection yoke core for use in television picture tube assemblies has just been announced by the Allen-Bradley Co., Milwaukee, Wis.

The yoke core is pressed as a ring of perfectly uniform section and circularity. It is then "cracked" into two halves for later assembly over deflection coils and fitting to the tube. The mated halves are held together mechanically in shipment to avoid possible damage in transit.

Such perfectly circular yokes eliminate the grinding, fitting, and setting necessary with quarter-round sections. Inner and outer surfaces are always perfectly concentric and parallel. The result is better convergence, greater color purity, and reduced assembly time.

New Television Tube

Type 6BY4, a new ceramic electronic tube, which will be employed in ultra-high frequency television receivers, features several refractory metals used by General Electric engineers. These metals, tungsten, molybdenum, tantalum, satisfy the stringent requirements placed on tube components during operation.

Sample quantities of tubes were produced in 1956. As in all triode tubes, there is a heater, a cathode, a grid, and an anode, but in this tube they are of microscopic size.

In its manufacture, the assembly is heated to 1,000°C., evacuated and sealed to form a compact unit.

This high temperature sealing prevents any gas release during normal tube types to operate at 400°C. to 600°C., far beyond the present temperature limits.

For Radiation Accumulation

Lightweight dosimeter pens, that can be charged in a few seconds, measure accurately and safely all radiation accumulation. They are a safeguard in industry, civilian defense, and other areas, wherever radioactive material is found.

The pens are produced by Universal Atomics Corp., 143 E. 49th St., New York, N. Y. Each one weighs 1/3rd ounce. The metal case in which each is enclosed clips onto a pocket.

Tiny Neon Lamp

A new subminiature neon lamp has been announced by the Circon Component Co., Santa Barbara, California.

The lamp is interchangeable in many assemblies with existing miniature aircraft lamps. It is considerably smaller than the previous flanged

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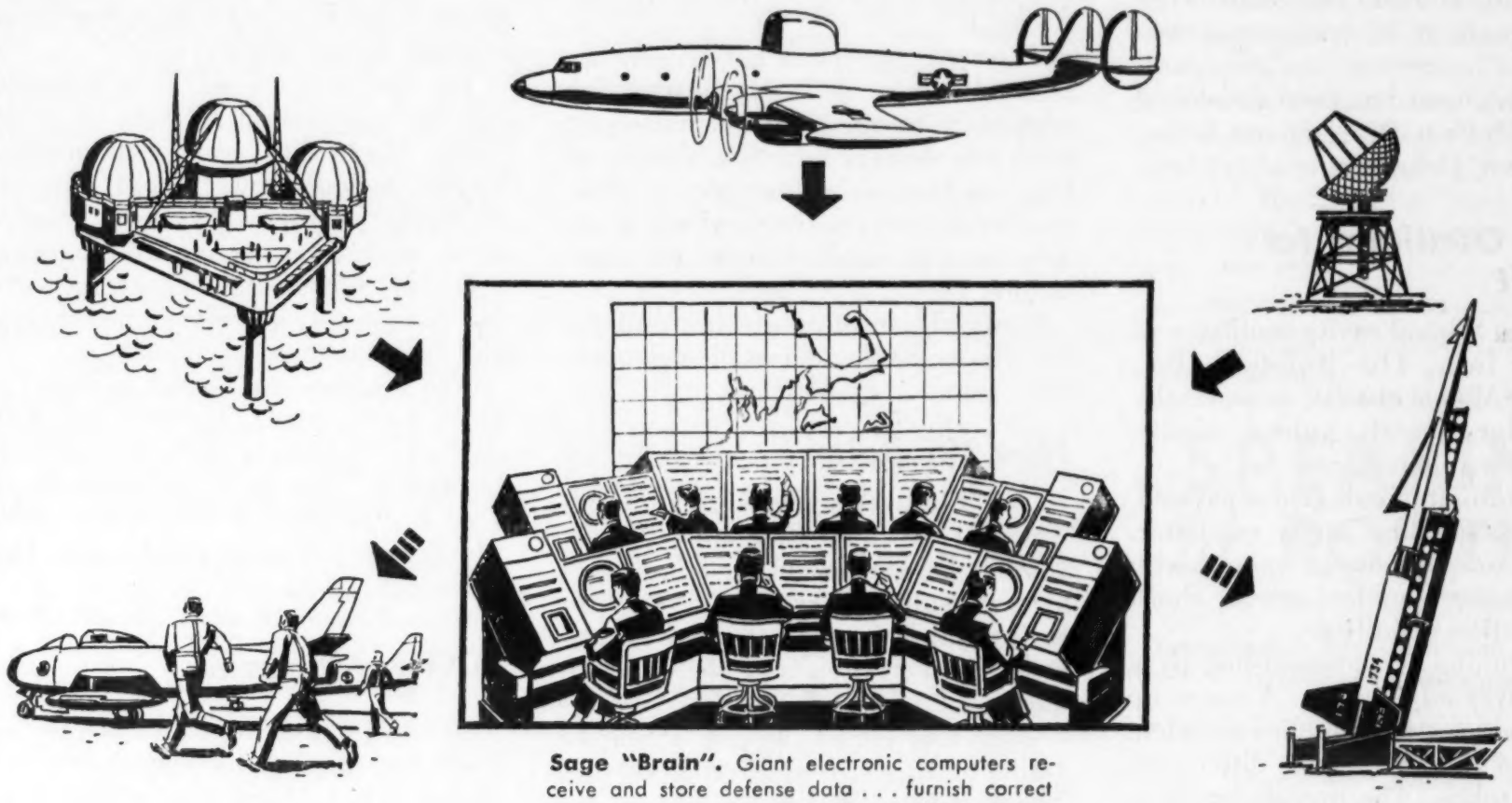

Sage "Brain". Giant electronic computers receive and store defense data . . . furnish correct picture to commanders at earliest possible moment.

New digital computer techniques and their application to radar data processing and weapons control have opened a new and expanding field of automation. The extensive classroom and laboratory training which precedes job assignment at Western Electric affords an excellent opportunity to enter this new and challenging electronics field as a part of the Bell System team.

MAIL RESUME TO:

Mr. W. M. Gesell, Room 902, Defense Projects Division
Western Electric Company, 220 Church Street, New York 13, New York
or Telephone Collect to: WOrth 4-5400 Ext. 6628

base neon lamps. It is useful in many indicator and computer applications.

The average life is over 25,000 hours. The lamp consumes only 0.04 watts, and gives off practically no heat.

Memomotion

Time-lapsed motion picture photography was used once by Walt Disney to make flowers appear to grow in seconds, compressing hours of natural time into a matter of minutes.

An extension of this technique can be used by industry, by traffic studies, for visual records of instruments and processes, or for many other applications.

"Memomotion" can be incorporated into almost all good motion picture cameras. The camera records every event that occurs before it, and adjusts to record the scene at predetermined intervals. An hour's operation can be viewed in as little as four minutes when film is shot at one frame per second and projected at the normal speed of 16 frames per second.

The equipment has been developed by E. I. DuPont De Nemours & Co., Wilmington, Delaware.

Cavity Oscillator for Aircraft

The new S-band cavity oscillator of Amerac, Inc., 116 Topsfield Rd., Wenham, Massachusetts, is especially suitable for aircraft, guided missile, and beacon applications.

It is a miniaturized, grid-separated, double coaxial line cavity oscillator. The light weight unit can operate with high efficiency under severe shock and vibration conditions.

Plate tuning is accomplished by a screw driver adjustment. A screw on the cathode section supplies sufficient tuning to accommodate differences between tubes. The overall length is 7"; the unit weighs 25 ounces.

New Copper-Plated Communications Wire

A new type communications wire of high strength steel with a heavy copper coating has been produced by National-Standard Co., Niles, Michigan.

The biggest volume application of the new product is expected to be in telephone, telegraph, and railroad signal lines. The wire will meet multiple requirements of high tensile strength, electrical conductivity, and resistance to fatigue and corrosion. Heavier coatings were developed specifically to meet needs of the communications industry.

The new wire costs less than solid copper wire. Its reinforcing strength is such that one-third of the poles required for suporting solid copper wires can be eliminated. This presents a great saving to the industry.

Produced in all standard sizes, the wire has a wide range of strength and hardness. Initial production is concentrated on existing commercial specifications.

Hyge Shock Simulator

A new device is now being manufactured by Consolidated Electrodynamics Corp's Rochester Division under license to Convair, a division of General Dynamics Corp.

This new product, the HYGE shock tester, makes it possible to simulate unlimited shock conditions with great accuracy. It was designed in order to test all components that must withstand high-level accelerations which are rapidly applied for sustained durations.

The arrangement of HYGE permits assembly into different forms for adaptation to specific problems. Giant units are designed to test objects as large as battleship components while smaller testers can be used on products as tiny and delicate as transistors.

Costs of operating are low and the HYGE is simple to install and operate.

New VG Relay

The Electronics Division of Elgin National Watch Company, Elgin, Illinois, has developed for missile and aircraft applications a new VG relay series which is characterized by exceptional vibration and shock resistance.

The tiny relay has a vibration rating at 15 g's from 55 to 2,000 cps. Shock is rated at 100 g's.

In the subminiature class, the new VG relay measures slightly less than ¾ cubic inches and weighs 1.3 ounces.

New Literature

Contractors Guide Revised

The most recent, revised edition of "Contractors Guide" has been published by the Department of the Army. It is a reference for Army Research and Development (R&D) to aid potential contractors.

The guide tells how to draft a proposal, who to contact to submit the proposal, and how actual contracts are arranged.

Any organization may contact R&D, even though no specific project is proposed, as a possible candidate for future work that may be of service to the Army.

BT Resistors Bulletin

Specifications and characteristics of Type BT Composition Resistors are covered in this 12-page bulletin. Detailed charts and graphs illustrate the data on construction, solderability, heat dissipation, resistance values, tolerances. Copies are available from International Resistance Co., 401 North Broad St., Philadelphia, Pa. Ask for Catalog Data Bulletin B-1A.

Compressive Electronics Study

A publication, Electronics Test Equipment Descriptive Data Sheets, an outgrowth of an evaluation program of the U.S. Air Force, has been released to the public.

The five volume set is a comprehensive compilation of data on over 1300 electronic test equipments. Topics include voltage and current measuring equipment, signal generating equipment, active and passive networks, power and energy measuring equipment, waveform measuring and/or analyzing equipment.

The volumes are bound in expandable, hard cover binders so that periodic "Additions & Revisions" can be added. The set is available from Carl L. Frederick & Associates, 4630 Montgomery Ave., Bethesda, Md. The price is $170.00.

DATA Magazine

A new publication called DATA reports and predicts significant developments in the Armed Forces and Government agencies.

It covers government innovations in everything from atomic energy to transportation, yet it is concise and quick reading. Articles are pruned severely to save reader time, but important details—although skeletonized—are retained. Complete source material for a listed article is available to the subscriber at no additional charge.

Subscription rate for the magazine and associated follow-up service is $12.00 annually. Interested readers may address, DATA, Box 6026, Arlington 6, Virginia, to place subscriptions or request a sample no-obligation copy of DATA.

MAN OF HIGH FIDELITY: EDWIN HOWARD ARMSTRONG, by Lawrence Lessing. J. B. Lippincott Co., New York, N. Y. 320 pages, $5.00.

Edwin Howard Armstrong, inventor of FM radio, was perhaps the last of the great individualistic inventors who refused to be swallowed up by the great industries. Armstrong's extreme independence colored the otherwise successful life of the inventor to the point of eccentricity, and led to his tragic, premature ending.

The scientist spent most of his latter years engaged in bitter court battles defending his patent rights on his inventions of earlier years. The biography incorporates the scientific and technical aspects of its subject with the personality of the man. Consequently, it is a dynamic, vigorous account of a twentieth century man of science.

Armstrong's three basic contributions to radio are the feedback current, the basis of modern radio and radar reception, and wide-band frequency modulation or FM radio.

This book deserves a place on the list of books for reading pleasure.

RADIO TELEMETRY, Second Edition, by Myron H. Nichols and Lawrence L. Rauch. John Wiley & Sons, Inc., New York, N. Y. 461 pages, $12.00.

In three subdivisions this book discusses basic theory as well as a cross-section of current practices in radio telemetry. The first section deals with methods, including time division systems, instruments for radio telemetry, and the problems of noise and error.

The second part, foundations, is devoted to modulation and multiplexing, and frequency analysis.

The final part treats techniques. Frequency-division and time-division radio telemetering systems are presented, and a brief section on remote control is included.

As an expansion of the first edition, which was a limited offset printing for the Air Force, this volume has been brought up to date with the inclusion of chapters describing telemetry systems in current use or development. Also added are an Index and Glossary.

MEN IN ARMS, A History of Warfare and Its Interrelationships with Western Society, by Richard A. Preston, Sydney F. Wise, and Herman O. Werner. Frederick A. Praeger, Inc., New York, N. Y. 376 pages, $6.50.

The impact of warfare has had a strong influence on society. In the political, social, and technological realms war has rendered changes, from the Greek era to the present. This book discusses the effects war has had on the total structure of western civilization.

In order to better understand warfare's present threat to civilization, the study of history is taken up in relation to the totality of human development.

The authors attribute modern technological developments and inventions to the demands generated by military needs.

This book will appeal not only to the reader with a special interest in military history and science but also to the serious general reader.

CIRCUIT THEORY AND DESIGN, by John L. Stewart. John Wiley & Sons, Inc., New York, N. Y. 480 pages, $9.50.

Both undergraduate and graduate students will find helpful this book on network and circuit theory, presented with an easily grasped pictorial representation. Pole-zero methods are stressed as a means for understanding and controlling linear frequency-dependent systems and for designing a variety of circuits.

Included are many topics related to circuit design: function design, normalization, and the use of ideal transformers. Each chapter concludes with a number of problems relating to practical design system.

THE QUARTERMASTER CORPS: OPERATIONS IN THE WAR AGAINST JAPAN, vol. 4, by Alvin P. Stauffer. Government Printing Office, Washington, D. C. $4.00.

The fourth and concluding volume of a series dealing with the problems and achievements of the Army Quartermaster Corps in World War II has just been written by the Chief of the Historical Branch of the Office of the Quartermaster General. Dr. Stauffer has to his credit several publications devoted to the activities of the Quartermaster Corps in World War II.

This volume describes the supply lines that spread from depots in the United States to widely scattered island bases, the difficulties imposed by lack of common storage and distribution facilities, and how supplies were brought to troops dispersed over tiny atolls and jungles.

The untiring efforts of the Corps to keep the troops provided with the supplies they needed are discussed with a serious awareness of how vital these duties were to the success of combat forces in the field.

For those who enjoy reading military history here is an intensive study of the Quartermaster Corps in operations against Japan.

HANDBOOK OF BASIC CIRCUITS, by Matthew Mandl. Macmillan Co., New York, N. Y. 363 pages, $7.50.

Designed for quick reference, this handbook presents in alphabetical order over 130 basic circuits: AM, FM, and TV. In a few pages each, the circuits are described with schematic diagrams. Their physical location in electronic equipment is given as well as an account of their characteristics, purposes, and functions. A given circuit is presented singly, but references are provided to other circuits that perform similar or related functions. Mathematics and formulas have been kept to a minimum to simplify the text.

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